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American Amalgamation Works—Chlorination.

CHLORINATION, though suited to every kind of gold ore, is mainly confined in the West to the "sulphurets" which are obtained in treating the ordinary gold ore. This ore contains a variable amount of iron pyrites, the average being, perhaps, two or three per cent. As we remarked in a former article, these sulphurets are in small works merely passed through a pan and subjected to long grinding, when a considerable proportion of the gold present will be taken up by mercury. When, however, the richness of the concentrated pyrites, or the magnitude of the works will warrant the expense, chlorination is resorted to, and very excellent examples of these works are to be seen at Grass Valley, California.

The process in general consists in passing dry chlorine through finely-powdered ore, which, however, must be free from sulphur, since this substance would cause a precipitation of the gold. The production of soluble perchloride of iron must also be avoided, for the reason that this precipitates gold from its solution. The theory of the process is the formation of a soluble salt of gold—the chloride—which is then removed by lixiviation, and the gold is obtained by adding a precipitating agent to the liquor. If any precipitation takes place within the dissolving cask, it is evident that so much of the gold will be lost. The precipitating agents most to be avoided are sulphur, antimony, arsenic and iron, though the peroxide of this metal is not injurious. The first step is, therefore, complete roasting. This is done in reverberatory furnaces, Brückner's cylinders, or Stetefeldt furnaces. The owdered and roasted ore is placed n the leaching vats, Fig. 1. These are merely wooden tubs swung on gudgeons, and with a filter on the bottom, made of pieces of quartz laid under a perforated earthenware cover. These vats are closed air-tight by rubber joints under the covers. Pipes in the covers connect the vats together, so that the gas which is introduced at the bottom passes through the whole row of vats. The ore is slightly dampened, but must not be wet.

Fig. 2 shows the gas generator. It consists merely of a lead chamber, containing an agitator of hard wood, and closed by a cover resting in a water joint. The whole rests on a sand bath. Between the generator and the leaching vats is placed a wash-bowl, where any hydrochloric acid in the gas is removed. When the operation is ended, the soluble chloride of gold is extracted by warm water,

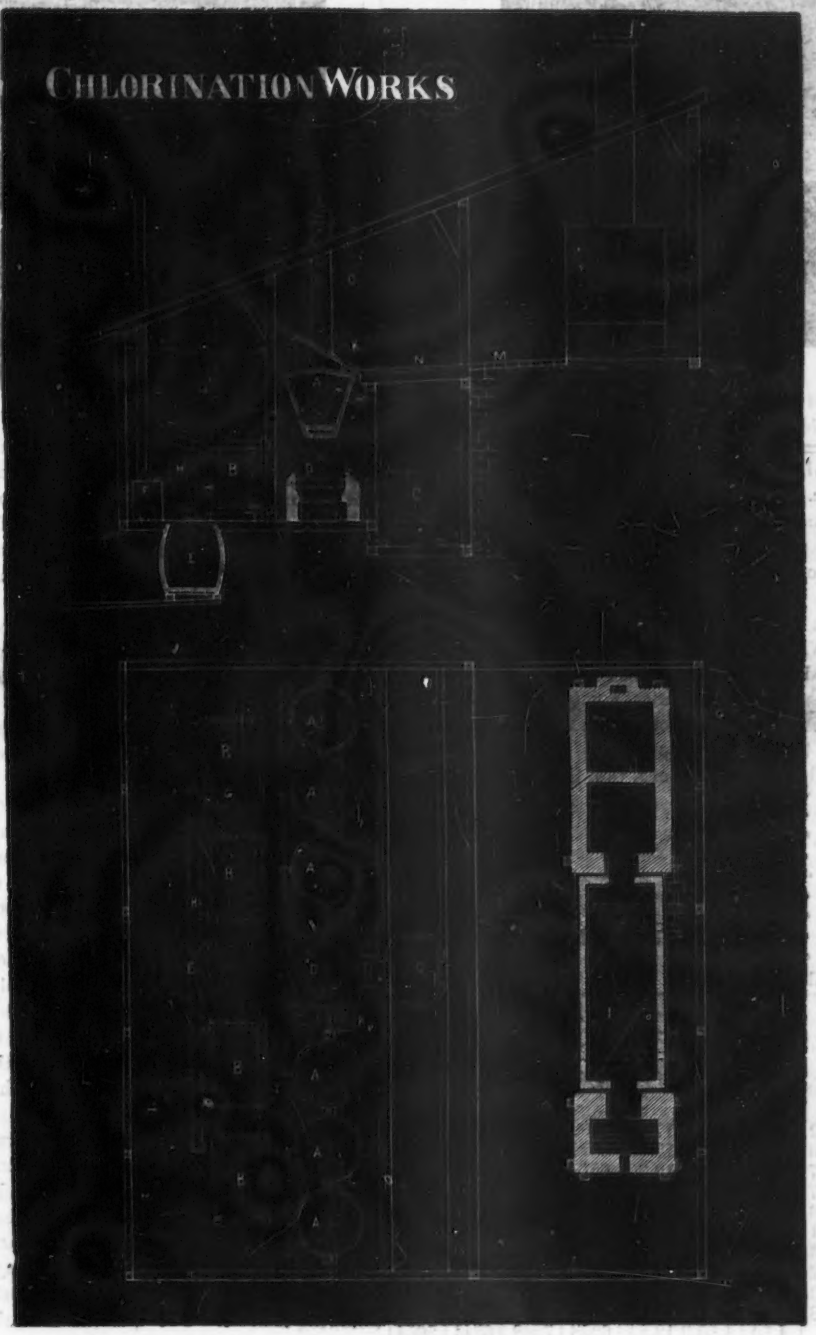

Figure 3.

and the spent ore is tipped into dump-cars. The solution is run to precipitating tubs, where the gold is thrown down by solution of sulphate of iron, oxalic acid, etc.

With proper care the process is a very perfect one, yielding 97 per cent. of the gold, which is very fine. It ought not to cost in California, according to Messrs. BOOTH & Co., of San Francisco, more than $12 a ton.

In Fig. 3 we have an arrangement of chlorination works which has been designed by Messrs. RIOTTE & LUCKNER, of San Francisco. It includes the use of the Brückner cylinder, which is seen at I, the starting point of the operation. The leaching vats are placed at A, in a row, with the gas generator D in the center. C is a rail car for removing the spent ore from the building, while the precipitating tubs are seen at B. At E is seen the waste tub, where the water runs through sawdust before being finally discharged.

Analytical Notes.

BY WOLCOTT GIBBS, M. D.

FOR the determination of *chromium*, the writer recommends precipitation with baric acetate at a boiling heat, with the addition of a little alcohol to the liquid and also to the wash-water, one-twelfth its volume.

For the *separation of uranium and chromic acid*, in presence of little chlorine or sulphuric acid, and in absence of phosphoric acid or other non-volatile acids, which precipitate mercurous compounds, precipitation with mercurous nitrate gives good results. In presence of such interfering substances the solution may be boiled with sodic hydrate, the sodic uranate filtered off and washed with hot water containing sodic hydrate. The sodic uranate is then dissolved in HCl and the uranium determined. The filtrate, containing the chromic acid is acidified with HCl, reduced by potassic nitrite, and precipitated with ammonia.

Chromic and uranic oxides in solution may be separated by boiling with sodic hydrate, adding bromine water, filtering, washing with hot water containing sodic hydrate, dissolving in hot nitric acid, expelling nitrous acid by boiling, and precipitating the small amount of chromic oxide with mercurous nitrate. This is added to the chromic oxide obtained from the first filtrate. From the last filtrate the uranium is separated as usual.

For the *estimation of magnesium* as pyro-phosphate, the writer recommends pre-

cipitation with microcosmic salt in boiling concentrated solutions, instead of with disodic phosphate.

For the *estimation of cobalt*, precipitate by mercurous nitrate at a boiling heat, neutralize any free nitric acid by boiling with mercuric oxide, wash with hot

Fig. 1.

water, containing a little mercurous nitrate, ignite carefully, and finally reduce to metallic state by hydrogen.—*American Journal of Science.*

The Calorific Value of Western Lignites.*

BY R. W. RAYMOND.

THE important question of the metallurgical value of the coals of the Rocky Mountains and the Pacific Coast is to be settled, of course, by practical experiment. Meanwhile, as I have had occasion to point out, the proximate analysis of these coals throws little light upon it, and is, indeed, likely to mislead the metallurgist, if he compares it with the results of similar analysis upon bituminous and semi-bituminous coals. With the view of showing how large a proportion of the material usually classed as "volatile matters" consists of combined water, or oxygen and hydrogen presumably in chemical combination, I have collected a number of ultimate analyses from various sources, in the following tables. The numbered analyses in the first table are as follows:

No. 1. Monte Diabolo coal—Analysist, H. S. Munro, Col. School of Mines.
2. Weber Cañon, Utah, " " "
3. Echo Cañon, " " " "
4. Carbon Station, Wyoming, " " "
5. " " " " "
6. Coos Bay, Oregon, " " " "
7. Alaska, " " "
8. " " " "
9. Cañon City, Colorado, " Dr. T. M. Drown, Philadelphia.
10. Baker Co., Oregon, " " "
11. Block Coal, Sand Creek, Ind. " Prof. E. T. Cox.

No.....	Carbon.....	Hydrogen.....	Nitrogen.....	Oxygen.....	Sulphur.....	Moisture.....	Ash.....	Combined Water.	Calorific Power I.	Calorific Power II.	Calorific Power III.	Temperature. Deg. C.
1.	59.72	5.08	1.01	15.69	3.92	8.94	5.64	17.65	5900	6472	5757	2520
2.	64.84	4.34	1.29	15.52	1.60	9.41	3.00	17.46	6056	6685	5912	2536
3.	69.84	3.90	1.93	10.99	0.77	9.17	3.40	12.36	6515	7172	6400	2603
4.	64.99	3.76	1.74	15.20	1.07	11.56	1.68	17.10	5892	6662	5738	2512
5.	69.14	4.36	1.25	9.54	1.03	8.06	6.62	10.73	6679	7264	6578	2630
6.	56.24	3.38	0.42	21.82	0.81	13.28	4.05	24.55	4768	5498	4565	2313
7.	55.79	3.26	0.61	19.01	0.63	16.52	4.18	21.38	4814	5766	4610	2375
8.	67.67	4.66	1.58	12.80	0.92	3.08	9.28	14.40	6522	6729	6428	2532
9.	67.58	7.42		13.42	0.63	5.18	5.77	15.10	7439	7845	7330	2683
10.	60.72	4.30		14.42	2.08	14.68	3.80	16.22	5768	6760	5602	2497
11.	72.94	4.50	1.79	11.77		4.50	4.50	13.24	6938	7208	6843	2654

This table affords some suggestive comparisons, to facilitate which a remark or two, explanatory of its construction, will be useful. In the ultimate analysis of coals, the proportions are frequently calculated (as, for instance, in the report for 1872 of Prof. Cox, State geologist of Indiana) upon the dry coal—that is to say, excluding the percentage of moisture. Thus the analysis (No. 11 above) of the Sand Creek block coal is given in that report (p. 18) as follows: Carbon, 76.38; ash, 4.71; hydrogen, 4.71; oxygen, 12.32; nitrogen, 1.88—the previously given proximate analysis having shown 4.50 per cent. of moisture. To secure uniformity in the table, I have reduced these results to the basis of a full analysis, including the moisture. The justice of including the moisture of the coal in calculations of its calorific power would be unquestionable, if the moisture were a constant element. This it is not; it varies in amount, according to the local conditions affecting the samples taken. But, on the other hand, some moisture is always present; and an amount not exceeding five or six per cent. is

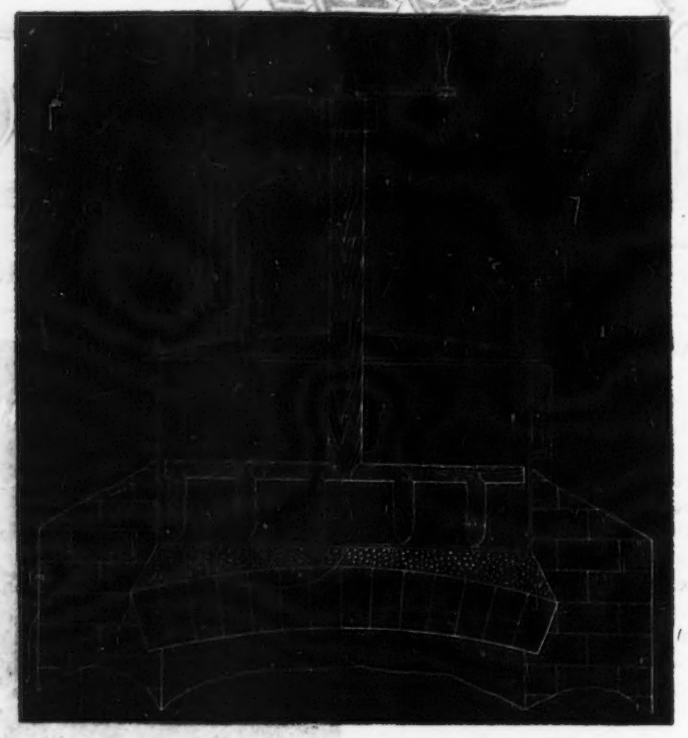

Fig. 2.

scarcely too great to be included in an estimate of average quality. Prof. FRAZER's proximate analyses of New Mexico coals give an average of 3 per cent.; of the Boulder Co. coal of Colorado, 16 per cent.; of the Evanston coal, 5.83 per cent.; and the average of 93 analyses of Indiana coals, made by Prof. Cox, gives 5.87 per cent. of moisture. Now this moisture is a greater detriment to the heating power of the coal than an equal amount of ash, since the water requires to be evaporated, while the ash does not. I have therefore included in the above table the percentages of moisture, as a basis for caloric calculations, though in several instances (notably Nos. 4, 6, 7, and 10) the amount of moisture is, perhaps, abnormally great, and the calorific power resulting from the calculation may be less than the average of the coal would give. There are, it will be noticed, three columns of calorific powers. In each of these the amounts are expressed in centigrade heat units, and therefore indicate directly the pounds of water which could theoretically be raised from zero to the boiling point by the combustion of one hundred pounds of fuel. The first column is obtained in the following manner: The amount of combined water is found by adding to the oxygen one-eighth its weight of hydrogen; the remaining hydrogen is multiplied by 34,462, the number of heat units evolved in the combustion of hydrogen; and the amount of carbon is, in like manner, multiplied by 8080, the caloric modulus for carbon. The sum of these two products is the number of heat units generated by the complete combustion of one unit of the fuel, containing the given proportions of carbon and available hydrogen. The heat units due to the combustion of the sulphur are disregarded, in view of the small amount of sulphur, its low calorific capacity (about 2240 units), and the circumstance that it exists partly in the form of pyrites, the decomposition of which still further diminishes the amount of heat from this source, and partly as sulphuric acid, causing a net loss.

The second column of calorific powers is obtained by a similar calculation on the supposition that the moisture is absent. The third column gives the closest approximation to the available heat, and is obtained by deducting from the figures in the first the amount of heat units required to vaporize the moisture and combined water. This is 537 units of heat for each unit of water.

The last column gives in centigrade degrees the maximum theoretical *temperature* to be obtained by the perfect combustion of the fuel. It is calculated in the following manner. The quantity of carbonic acid, sulphurous acid, water and nitrogen, resulting from the combustion of one unit of the fuel in atmospheric air is determined, and the quantity of each of these substances is multiplied by its specific heat. The sum of these products, which we may call the temperature unit, is the number of heat units required to raise the mixture one degree in temperature. Dividing the number of heat units given in column III. by this temperature unit, we obtain as a quotient the number of degrees centigrade through which the temperature of the fuel will be raised, or, in other words, the average temperature of the products of combustion, on the supposition that the initial temperature is zero, that the combustion of carbon and hydrogen is complete, that no superfluous air is admitted, and that there is no loss by radiation and conduction during the process. The calculation may be illustrated by displaying a single example in detail.

We have in analysis No. 1 of the table the following constitution of the fuel:

* A paper read before the American Institute of Mining Engineers, at Philadelphia, May 21, 1873; being also a chapter in the forthcoming Report of the Commissioner of Mining Statistics.

Carbon, 59.72 ; hydrogen, 5.08 ; nitrogen, 1.01 ; oxygen, 15.69 ; sulphur, 3.92 ; moisture, 8.94 ; ash, 5.64. To find the combined water, we add to the amount of oxygen the proportional amount of hydrogen, or one-eighth, since water consists of one part hydrogen and eight parts oxygen. This gives us 17.65 combined water, leaving 3.12 of hydrogen available for the generation of heat. But the moisture and combined water must be evaporated by the combustion of the rest of the fuel ; and the heat absorbed in this evaporation is 537 heat units. Hence, to evaporate 26.59 hundredths of water will require (temperature apart) 142.78 heat units, which must be subtrac ed from the calorific power in column I., leaving 5757.22, as per column III., the available amount of heat.

We now proceed to determine the temperature of the products of combustion. A simple calculation based upon the chemical equivalents shows that those products will be as follows :

59.72 carbon will unite with	159.28	oxygen, forming	219.00	CO_2
3.92 sulphur "	3.92	" "	7.84	SO_2
3.12 hydrogen "	24.96	" "	28.08	HO
26.59 combined water and moisture.....			26.59	HO
Total oxygen required from the air....	188.16			
Amount of nitrogen corresponding to this amount of oxygen in the air...	629.86			
Amount of nitrogen already in the fuel	1.01			
Total nitrogen in the products of combustion....			630.87	N

The specific heat of carbonic acid—that is, the number of heat units required to raise a unit of this gas one degree of temperature—is 0.216 ; the specific heat of sulphurous acid is 0.155 ; that of steam is 0.475 ; and that of nitrogen is 0.244. Applying these numbers, we have for the heat rendered latent by each substance in one hundred units of the above mixture of gases:

CO_2,	219.00 × 0.216 =		47.304
SO_2,	7.84 × 0.155 =		1.215
HO,	54.67 × 0.475 =		25.968
N,	630.87 × 0.244 =		153.932
			228.419

That is to say, it will require 228.419 units of heat to elevate the total products of combustion of 100 units of fuel one degree centigrade ; or, 2.28419 is the specific heat of the products of combustion of one unit of the fuel. Dividing 5757.22, the number of available heat units from the combustion of one unit, by 2.28419, the heat absorbed for each degree of temperature, we have 2520, which is the temperature in degrees centigrade of the products. It need scarcely be said that the unit of weight employed is immaterial to this calculation. The temperature is the same, whatever the quantity of fuel, provided the combustion takes place as above supposed, and the gases are not compressed.

It should be remarked, finally, that the oxidation of iron in the ash has not been taken into account in the foregoing calculations. The analyses give no means of determining it ; but it is certainly insignificant as a source of heat, and its contribution to the resultant temperature would be reduced by the diluting effect of an additional quantity of nitrogen in the air required for its oxidation.

Pure carbon yields by combustion to carbonic acid 8080 heat units ; and the theoretic resultant temperature of the carbonic acid produced is 2720.° It will be seen that some of the coals in the table, particularly the lignites of Cañon City, Colorado and Carbon Station, Wyoming, approach the calorific power of carbon.

Moreover, several of the lignites nearly equal, and that of Cañon City surpasses, the black coal of Sand Creek in calorific power. Yet the latter is successfully used in the smelting of iron. We are therefore led to conclude that high metallurgical temperatures can be obtained from the best lignites of the Rocky Mountains, and that only their physical behavior, which hinders a complete combustion, prevents their use, even in shaft furnaces. That they can be utilized by means of gas producers, I think there is no room to doubt.

Abstract of the Address of J. Lowthian Bell,

PRESIDENT OF THE BRITISH IRON AND STEEL ASSOCIATION.

IF the founding of the Iron and Steel Institute has not created a desire for accurate knowledge, based on sound scientific investigation, it has done much, by the character of its meetings and discussions, to foster and develop it. In this we have received material help from the labors of our secretaries, Mr. JONES and Professor FORBES. From the former we have early intelligence of what is being done in the British iron and steel trades, as well as of the proceedings of other learned societies, when they embrace matter likely to interest the members of our own. In his periodical report, our foreign secretary gives us an excellent account of the progress of these industries in other nations, which he accompanies by numerous references to scientific discovery and literature extracted from the published works of Continental authors. It must be admitted that the cultivation of metallurgical science has been much more industriously pursued abroad than has hitherto been the case in this country, and hence the value of these extracts obtained by the exercise of great labor on the part of Mr. FORBES. Let us now hope that the increasing weight attached by ourselves to scientific aid, may induce our own philosophers to pursue inquiry in directions which, while it affords abundant opportunity for congenial investigation, may also be highly useful and valuable to society at large.

It will be in the recollection of earlier members that at our inaugural meeting our first president gave us an interesting account of the history of the iron manufacture from the remotest times down to the present day. It would be impossible in the absence of any trustworthy record, to allot, even during the last three centuries, to each nation the proper amount of credit to which it is entitled for aid rendered in advancing this branch of metallurgy. So far, however, as concerns the production of iron, and its application to those purposes which have rendered it a necessity of civilized life, we need not go back beyond 1806, when the production of pig-iron in this country did not exceed 260,000 tons*

We have very recently been warned again of the present aspect of foreign competition. It is said that this threatens, as it did ten years ago, if not to extinguish, yet seriously to cripple a trade which has occupied a very honorable and conspicuous position in our manufacturing annals. Doubtless, the progress made in other lands has been more marked during the last twenty or thirty years than in our own case, but the change arose from a rapid adaptation of our appliances, and not from any important discoveries abroad. Until, indeed, we are made acquainted with a series of improvements like the puddling process, the substitution of the rolling mills for forge hammers, the hot blast, and our last grand achievement of Bessemer steel, we must permit our national pride the luxury of believing that it is to ourselves, more than to any other people, that the world is indebted for the advance which enables it to be furnished with cheap iron. In striving to attain economy in production, our manufacturers have not been insensible to the importance of being able to furnish the metal in which powers of great resistance are not incompatible with comparative lightness. Had this been overlooked, the high speeds of our express trains would have been fraught with danger, marine engines could never have been compressed in the small space they now occupy, and no one would have dreamt of throwing a projectile of 600 or 700 lb. weight for a distance of five miles from a gun made entirely of English iron.

Recognizing, as we all now do, the value of inductive reasoning, it certainly is a matter of surprise how great the progress has been in the iron industry of this country, made independently of all scientific teaching. This is probably due to the opportunities of experiment which have been afforded by an enormous trade, fostered by great capital and by almost unlimited natural resources. To judge correctly of the nature of the growth, which has culminated in the present wonderful expansion of this branch of manufacture, we should have to arrange alongside of our brilliant successes a list of our costly failures, or of the irrational patents of so-called improvements in the manufacture of iron and of steel. Had we, as a nation, been a little more systematic in our methods of study, it is possible some of the fruitless attempts at improvement made by ourselves might have been avoided, and less time and money lost in endeavors to render assistance to others who had neither science nor practice to guide them.

Leaving our past history, and directing our attention to events as they are now passing before us, there is nothing more certain to arrest it than the extraordinary disturbance in our position as iron manufacturers occasioned by the recent greatly altered value of fuel.

Having regard to the large quantity of coal burnt in producing a railway bar, it is not too much to say that if anything like the former average price of ordinary pig-iron, viz., about 60s. per ton, were to prevail, the iron trade of this kingdom would, with fuel at even half its present price, commence to decline. This was exactly what did happen when timber grew scarce, and was worth more for other purposes than that of smelting. Of course, any process of partial extinction as that supposed possible would be very gradual, the weaker districts succumbing in the first instance. The very diminution in the production of iron would of itself liberate so large a quantity of coal as would tend to restore an equilibrium in the price of this element of consumption. This is obvious when it is borne in mind that out of 107½ millions of tons of coal raised in this kingdom in 1869, 32¼ millions were devoted to the manufacture of pig and malleable iron.†

In the year 1862 the make of the former, in Great Britain, was close on four millions of tons ; in 1872 it was probably 6¾ millions of tons. At this rate of increase, in 1882, it ought to reach about 11½ millions of tons, and for this, and the probable extension of malleable ironworks, judging by the experience of 1839, something like sixty-five million tons of coal might be required. Alongside of this tendency to increase, which has marked the history of the iron trade, it is only fair to assume that other sections of British industry would not remain idle in this respect. Under such circumstances it becomes important that we should consider how far our coalfields would be able to meet any greatly increased demand on their resources for an article which is more or less a necessity for almost every variety of manufacturing enterprise.

It is not my wish to weary you with statistical details, because the erection of new mills in the cotton and woollen districts, the extension of our railways, the substitution of steam for sails in navigation, inform us that the same activity which prevails in the iron trade is also on all sides adding to any difficulty which an inadequate supply of coal must entail upon ourselves.

On all hands it is admitted that the increase in the yield of our collieries has recently been below that of the fresh demands it has had to satisfy. In my opinion an important addition can and will be made to their present out-put ; but it is very possible that the time is approaching when any extension of manufacturing operations in this country will have to be regulated, not by the requirements of society for their produce, but by the means our coal mines possess of furnishing the fuel required.

It must not, however, be supposed that the recent very rapid rise in the price of coal has to be accepted as presenting any standard by which we can estimate the extent of the actual deficiency. As is well know, a very moderate shortness in the supply instantly makes itself felt in the market, and this shortness happening when almost every description of manufacture was in an unusually active state, the effect on the selling value of coal and coke has assumed a highly exaggerated

* Scrivenor on the Iron Trade.
† Report of Royal Commission on matters relating to Coal.

form. In like manner, the moment the demand falls, or even is expected to fall, a trifle below the powers of production of our collieries, we may expect to experience a very notable diminution in the price of these commodities.

My own impression is that an addition of less than five per cent. to the quantity of coal raised during the past year would, in all probability, have sufficed to keep in check the exorbitant prices it has commanded in the market; but in the meantime our own trade, owing to the magnitude of its consumption, has upon certain occasions been regarded as the chief cause of the recent and present scarcity. It will, I think, be found on enquiry, that the iron and steel works have not, during 1872, used much more than their usual proportion of the total output, *i. e.*, instead of burning, as in former years, 29 to 30 per cent. of the gross produce of the collieries, the quantity consumed may have reached 33 per cent. of the whole.

However this may be, it behoves us, after our recent experience, to reflect on our position in the event of a continuance or a recurrence of any great competition for so essential an element in our operations as coal. It is obvious, in such a case, that industry will suffer most into which the cost of fuel enters most largely. Now, roughly, according to the figures in the report of the "Royal Commissioners appointed to enquire into matters relating to coal," every 1000 tons raised in this kingdom is disposed of as follows: in paper making and tanning, 6; in smelting copper, lead, tin and zinc, 8; in breweries and distilleries, 18; in articles of clay and glass, and lime-kilns, 31; in railway work, 20; in waterworks, 14; in chemical manufactures, 19; in steam navigation, 30; in textile fabrics—of wool, cotton, silk, flax, and jute, 42; in gas works, 60; in mining operations, 67; in coal exported to foreign countries, 92; in general purposes, chiefly steam engines,' 121; in domestic use, 172; in iron and steel works, inclusive of that required for their steam power, 300; total 1000.

Hence it would appear that the iron trade of this country requires for its prosecution as much coal as any two of the largest sources of consumption, and between seven and eight times that of textile fabrics, one of which alone, viz., cotton, is regarded as the most important in point of money value of all our manufactures.*

The mere extent of any industrial undertaking can scarcely be regarded as being detrimental to the national well-being, even although it involves the destruction of the vast weight of coal just mentioned as being set aside for the ironworks of the country. The case, however, is materially altered if it can be proved that the fuel we employ is greatly in excess of that which is really necessary, and beyond that which actual experience has proved elsewhere can be made to suffice. An opinion has been expressed in high quarters that the British iron makers are accountable for a wilful waste of national wealth by their reckless expenditure of coal; indeed, only a month or two ago, a minister of the Crown informed the world from his place in Parliament that he had "conversed with an intelligent gentleman connected with the iron trade, who had travelled in France and Germany for the purpose of comparing the different modes of production and manufacture, and no one circumstance struck him so much as the difference between the economical use of coal in France and Germany and its wasteful consumption in this country."

I intend, in the time you have been so good as to place at my disposal, to consider how far we have laid ourselves open to this reflection upon our manufacturing skill and intelligence. In thus examining the fuel consumed in some of our processes, and comparing our position in this respect with that of other nations, I propose to avail myself of the opportunity to offer a few observations on some questions connected with the processes themselves, which possess a high degree of interest at the present moment.

The natural starting-point in such an enquiry as that contemplated is the blast furnace, because it is the first step in the routine of our operations, whatever the ultimate product sought for may be; and, secondly, because of the whole quantity of fuel required in the iron trade, it alone absorbs one-half.

In the gradual improvement of this very important item of the ironmasters' plant, this country may be said to stand without a rival; indeed, with the single exception of the use of the waste gases—no doubt a most valuable discovery—every step in the march of amelioration is due to British skill. For more than half a century, after DARBY succeeded in introducing Dudley's plan of substituting mineral fuel for charcoal, the blast-furnace may be said to have remained in a stationary position. This was the state of affairs when NEILSON, fifty years after DARBY's time, enabled us gradually to quadruple the make of a furnace, and reduce the consumption of coal on the ton of iron to less than one-half of its previous amount. Some ten or fifteen years ago, and about thirty years after the date of Neilson's hot-blast patent, the smelters of the North of England, disregarding the failures which had accompanied former attempts at enlargement, added by degrees to the height of their furnaces until it was nearly doubled. At the same time their attention was directed to a further increase in the temperature of the blast employed in the operation. These two improvements effected a saving of fully 35 per cent. of the fuel previously consumed, and each furnace was enabled to run 400 tons, instead of half this quantity, per week.

When it is remembered that this change was effected in a new district, where there was not a work much above a dozen years old, and that in an incredibly short space of time about forty furnaces were demolished and others erected at double their cost, it cannot be maintained, with any justice, that indifference to the economy of fuel is a reproach that can be laid at our door. This is rendered more conspicuous by the fact that the great outlay in question upon plant was incurred when coke was less than one-third of the price it now commands.

Reduced into figures, it may safely be stated that, with the perfect mode of withdrawing and utilizing the gases, and the improvements in the furnace just mentioned, the present make of pig-iron in Cleveland is produced with 3¼ millions of tons of coal less than would have been needed fifteen years ago. This is equivalent to a saving of 45 per cent. of the quantity formerly used.

The explanation, which appears to me sufficient to account for the phenomena which manifest themselves in connection with the use of hot blast, is that it is *time*, as well as heat, which determines the difference of action between it and that of cold air. In addition to the heat units contained in the blast, and which in effect are precisely equivalent to a similar quantity of heat evolved by the combustion of the fuel at the tuyeres, there is an increase in the period of exposure of the ore to the reducing current of gas, and this it is which, in my opinion, accounts for the remainder of the saving. In the case of the Guerche ore, 25 cwt. of fuel was able to smelt a ton of iron, whereas for some ores in England, as, for example, those of Shropshire, 40 cwt. of coke was needed. The ores of both localities are about of the same richness, and require for fusion about the same quantity of limestone, cold blast being used in each case. I ascribe this difference in the results obtained to the circumstance that different ores, as has been repeatedly proved, are reducible at very different rates of speed, and in the two instances under consideration, that of England was by far the least susceptible of deoxidation. A necessary consequence of this dissimilarity is that the Shropshire ironstone demands a longer exposure to the current of reducing gas than that smelted at Guerche. This longer exposure is secured by the generation of a larger volume of carbonic oxide for every ton of iron made, in other words, by the use of more fuel. Now, it might be supposed that an equally beneficial effect could be commanded by allowing the furnace to drive more slowly; but experience teaches us that no advantage accrues from this mode of treatment. The reason of this is, that heat, as well as chemical action, is involved in the operation, and if we seek to prolong exposure by the diminution in the speed at which the heat-intercepting solids pass downwards, the temperature of the escaping gases instantly rises and a loss ensues, which neutralizes, or more than neutralizes, the gain due to an increased duration of exposure.

An extended period of contact between the reducing gases and the ore may be arrived at in another way without interfering at all with the powers the descending solids possess of intercepting the heat which is being carried forward in the contrary direction. To achieve this, all that is required is to retain the original rate of velocity at which the solid materials travel downwards, and make the column through which they have to pass so much the longer. This was tried at Lilleshall, and it is very remarkable that a ton of iron is there smelted with cold air in furnaces 71 ft. high, with exactly the same quantity of fuel as is consumed in furnaces about 20 ft. lower, but fed with hot blast.

But it may be asked, how the mere heating of the blast extends the time allowed for reduction and heat interception. This arises as follows:—A certain quantity of heat is essential for the general purposes of the furnaces, which heat, in one working with cold blast, is derived exclusively from the fuel, and the quantity of carbon required to be burnt to afford the necessary calorific effect determines the quantity of gas, and of course determines its velocity upwards. If, however, a portion of the necessary heat is generated, not by combustion of carbon in the furnace, but is conveyed into the hearth by the blast, we have the same calorific power as before, but contained in a smaller volume of gaseous matter, and the reduction of volume at the same time lessens the speed of the current towards the throat; in other words, permits a longer sojourn of the gas in the furnace.

We have, then, in the higher furnace fed with cold air, a portion of the reducing gas, carbonic oxide, becoming, as far as the nature of the operation will permit, charged with oxygen which it abstracts in small quantities from a larger number of portions of iron oxide contained in the longer column. In the shorter furnace driven with hot air each portion of carbonic oxide becomes similarly charged with oxygen, by passing over fewer portions of iron oxide, but remaining longer in contact with each.

Now, the inquiry which such an explanation as the foregoing prompts is, whether a furnace could have its height so increased as to dispense with heating the air altogether, and thus save the fuel used in the hot-blast apparatus. Approximately, two-thirds or three-fourths of the quantity of heat contained in the air when at about 900° F., is found in the gases as they leave the furnace. If, then, we could so arrange matters as to reduce the temperature of these gases to that of the atmosphere, we might diminish the heat of the blast to something like 350° F. It seems pretty certain, however, that a large proportion of the heat found in the gases is due to chemical action going on so near the top of the furnace that it is highly improbable much change can be effected in the way suggested. This means, looking at the price of fuel used in the furnace and that employed in the hot-air stoves, that it will be found advantageous to continue to heat the air to something above 800° F.

The extent to which the reducing gas (carbonic acid) can take up oxygen offers an impassible barrier to diminishing the fuel used in the furnace beyond a certain point. What this precise minimum point is may be a subject of some doubt, but in my opinion we are very close upon it when we are using about 21 cwt. of Durham coke in smelting a ton of foundry iron from the usual run of Cleveland ore.

When it is stated that in practice we often come within 5 per cent. of this theoretical quantity, the ironmasters of this country cannot be justly accused with wasting fuel, at all events in the blast furnace. On the other hand, I apprehend that we, in common with our friends in Germany, France, and elsewhere, are not sufficiently mindful of the heat capable of being afforded by our waste gases. This arises chiefly from the unnecessarily high temperature at which, as a rule, the products of their combustion are permitted to escape into the atmosphere. This might, in a great measure, be suppressed by the use of apparatus of increased power. Of course this is a question to be decided upon commercial considerations alone, for if the additional size of boilers or other apparatus in connection with our smelting establishments involved a greater money value in interest and repairs than the saving of fuel was worth, we must be content to suffer the waste. At the same time it must be remembered that the relation between the saving and its cost is a very fluctuating one, and that which was impracticable, commercially speaking, with coal at one price becomes imperatively necessary when its value is quadrupled, as has happened very recently.

* By the kindness of Sir WILLIAM FAIRBAIRN, Bart., I learn that, even at the present unexampled high price of coal, the cost of fuel is only ·5d. for spinning one pound of No. 40 yarn worth 14½d.—equal to 3·45 per cent. of the value of the yarn. To weave one pound of heavy cotton cloth, the value of which is also 14½d., coal worth ·37d. is consumed—equal to 2·55 per cent. of the value. Thus the total consumption of coal for spinning and weaving is about 6 per cent. This, calculated on the cost price of the fuel, would not exceed 2 per cent., whereas the expenditure for fuel on rails, similarly estimated, is about 25 per cent. of their total cost.

THE COAL TRADE.

NEW YORK, May 22, 1873.

The leading companies report an increasing demand, and seem to think that the world is pretty well settling down to the conviction that the combination is sure to have its own way. Still the next auction sale will cover only 80,000 tons, instead of 130,000 tons, as at this time last year. There does not appear to be any marked improvement in the business of the country, for manufacturers of all kinds are complaining of hard times, and though coal is leaving first hands with more readiness than it has done, many of the middlemen find their usual channels of trade closing up. The lively times which the great companies are enjoying do not, therefore, extend through all branches of the trade. The usual monthly advance has taken place, as we announced a week ago, and the prices for the next month are given below.

Pennsylvania Coal Company, Newburgh:

Lump	$4.60 per ton.
Steamer	4.60 "
Grate	4.70 "
Egg	4.80 "
Stove	5.10 "
Chestnut	4 60 "

60 cents per ton additional for delivery at New York.

Philadelphia and Reading Coal and Iron Company, Port Richmond:

	L'mp.	St'r.	Brok.	Egg.	St'e.	Ch't.
Hard White Ash Coal	$4.20	$4.20	$4.30	$4.30	$4.50	$3.65
Free Burning White	4 20	4.20	4.30	4.30	4.50	3.65
Schuylkill Red Ash	—	—	4.30	4.45	4.65	3.75
Alaska Red Ash	—	—	4.30	4.30	4.50	3.65
Shamokin White Ash	—	—	4 55	4.70	4.70	4.00
Shamokin Red Ash	—	—	4.55	4.70	4.70	4.00
North Franklin	—	—	4.60	4.75	4.85	3.75
Lorberry	—	—	4.75	4.75	4.75	4.00
Lyken's Valley	—	—	—	5 70	5.70	4.45

Canal Freight to New York, $1.15.

On and after June 2d, 1873, and until further notice, a Drawback of 20 cents per ton will be paid on all Anthracite Coal shipped from Port Richmond.

Delaware and Hudson Canal Company at Rondout:

Furnace, Lump	per ton of 2240 lbs.	$4.65
Steamer, Lump	"	4.75
Grate	"	4.85
Egg	"	5.00
Stove	"	5.20
Chestnut	"	4.65

Freight to New York, 65 cents.

Wilkesbarre Company, Hoboken or Port Johnson:

Lump	$4.65
Steamer	4.75
Broken	4.85
Egg	5.00
Stove	5.20
Chestnut	4.65

Old Company's Lehigh, Boom Run, Plymouth and Newport Coals, Port Johnson:

	Old Co.'s Lehigh.	R'm Run.	Plymouth.	Newport.
Lump	$5.60	$5.45	$	$
Broken	5.45	5.30	4.95	4.95
Egg	5.45	5.30	5.20	5.10
Stove	5.50	5.45	5.40	5.30
Chestnut	4.80	4.75	4.70	4.70

Freight to New York, 35 cents.

Anthracite Coal Trade for 1872 and 1873.

The following table exhibits the quantity of Anthracite Coal passing over the following routes of transportation for the week ending May 18, 1873, compared with the week ending May 18, 1872.

COMPANIES.	1872. WEEK.	1872. TOTAL.	1873. WEEK.	1873. TOTAL.
*Phila & Reading R.R†	92,786	1,604,442	98,864	1,836,206
*Schuylkill Canal	23,463	201,390	22,235	140,509
*Lehigh Valley R. R.	69,555	1,342,243	64,694	1,330,427
Lehigh & Sus. R. R.	37,765	580,926	41,309	715,761
" " Canal	21,182	120,704	24,135	106,223
Scranton North	16,241	231,301	15,665	247,577
" South	43,653	869,458	53,918	848,859
Penn. Coal Co., rail	25,699	422,421	32,641	375,101
" " " canal	237	832	239	1,745
Del. & Hud. C. Co. Canal	50,594	223,547	50,891	216,686
" " East	15,180	246,224	5,208	142,870
" " West	7,926	126,789	9,635	161,519
" " South	8,227	131,540	5,295	120,227
Shamokin	11,689	165,621	13,694	123,513
Trevorton	....	....	....	....
Lykens Valley Coal Co.	....	....	....	....
Wyoming North	....	....	....	....
Wyoming South	....	....	....	....
P. N. Y. C. & R. R. Co.	12,709	248,932	14,610	268,000
Williamstown Col'y	....	....	....	....
Big Lick Col	....	....	....	....
Total	436,906	6,456,390	453,093	6,705,283
1872			436,906	6,456,390
Increase			16,187	248,893
Decrease				

These figures are for the week and fiscal period commencing Nov. 30.

† Less coal transported for Company's use and Bituminous coal.

Bituminous Coal Trade, 1873 and 1873.

The following table exhibits the quantity of Bituminous Coal passing over the following routes of Transportation for the week ending May 17, 1873, compared with week ending May 18, 1872.

COMPANIES.	1872. Week.	1872. Year.	1873 Week.	1873 Year.
C. & O. Canal	19,202	156,060	21,326	133,425
B. & O. R. R.	25,494	440,169	29,771	504,061
Penn. S. Line	....	.....	1,143	36,152
H. & B. T. R. R.	6,659	101,417	9,197	177,368
*Harrisburg & D	8,057	199,035	7,675	139,602
*L. V. R. R.	837	13,055	676	12,528
P. & N.Y.C. & R. Co.	2,205	142,317	7,232	126,524
Cumberl'd Branch Canal	5,368	51,076	2.224	22.424
" Railroad	467	4,999	2,233	41,280
Total	68,259	1,108,198	81,477	1,193,364
	....		68,259	1,108,198
Decrease	....			
Increase			13,228	85,166

Philadelphia & Reading Railroad and Branches.

COAL TONNAGE

For the Week ending Saturday, May 17, 1873.

BY RAILROAD.—ANTHRACITE.

PASSING OVER MAIN LINE AND LEB. VAL. BRANCH.

	Tons. Cwt
From St. Clair	26,292 17
" Port Carbon	3,939 10
" Pottsville	2,759 10
" Schuylkill Haven	25,724 00
" Pine Grove	5,022 15
" Tamaqua	10,625 11
" Harrisburg	
" Dauphin	3,776 14
Total	78,209 17

FOR SHIPMENT BY CANAL.

Passing Frackville Scales	7,470 17
" Mill Creek "	1,563 15
" Schuylkill Valley Scales	1,396 09
" Mt. Carbon "	1,089 19
" Oressona "	8,118 15
" Pine Grove "	898 10
" Tamaqua "	774 08
Total	21,312 13

SHIPPED WESTWARD VIA CATAWISSA AND WILLIAMSPORT BRANCH AND NORTHERN CENTRAL RAILROAD.

Via Catawissa & Williamsport Br.	114 09
" N. C. R. R. passing Locust Gap	2,505 05
" " " Shamokin	5,414 11
" " " Herndon	....
Total	8,034 05

SHIPPED WEST OR SOUTH FROM PINE GROVE.

Via Schuylkill & Susquehanna R. R.	699 19
" Lebanon & Pine Grove Branch	670 17
Total	1,370 16

CONSUMED ON LATERALS.

From Frackville Scales	511 02
" Mill Creek "	524 02
" Schuylkill Valley Scales	1,234 12
" Mt. Carbon "	460 11
" Oressona "	359 04
" Pine Grove "	25 17
" Tamaqua "	478 04
Total	3,563 08

LEHIGH AND WYOMING COAL.

Received via Silverbrook Junction, Sent East	6,044 05
Cat. & Wpt. Br. Sent West	32 18
" " Rupert, Cat. & Wpt. Br.	....
" " Allentown, E. Penn's Br.	10 17
" " Alburtis, " "	....
" " Oreland, G. & N. Br.	1,172 11
" " Willow Street R. R.	406 00
Total	7,665 11

BITUMINOUS.

From Harrisburg	7,625 05
" Connecting R. R., G. & N. Br.	
" Junction R. R.	50 00
Total	7,675 05

COAL FOR COMPANY'S USE.

Anthracite	6,811 13
Bituminous	287 18
Total	7,099 11

RECAPITULATION.

	Total for Week.	Corres'p'g week last year.	Increase and Decrease.
Passing over Main Line and Leb. Val. Branch	78,209 17	81,532 03	d 3,331 06
For Shipment by Canal	21,312 13	24,710 00	d 1,397 07
Shipped Westward via Northern Central R. R.	8,034 05	5,507 01	i 2,527 04
Shipped West or South from Pine Grove	1,370 16	2,479 05	d 1,108 09
Consumed on Laterals	3,563 08	2,088 08	i 1,525 00
Lehigh and Wyoming Coal	7,665 11	1,199 10	i 6,465 01
Total Anthracite paying freig't	120,177 10	115,496 07	i 4,681 03
Bituminous	7,099 11	8,057 09	d 382 04
Total of all kinds paying freig't	127,852 15	123,553 16	i 4,298 19
Coal for Company's use	7,099 11	4,128 11	i 2,971 00
Total Tonnage for Week	134,952 06	127,682 07	i 7,269 19
Previously this year	2205789 07	2094280 14	i 111,508 13
Total to date	2340741 13	2221963 01	i 118,778 12

SHIPPED BY CANAL.

From Schuylkill Haven	20,629 10	20,658 10	d 29 00
" Port Clinton	1,605 00	1,578 00	i 28 00
Total Tonnage per Week	22,236 10	22,236 10	d 1 00
Previously this year	118,274 00	181,925 19	d 63,651 19
Total to date	140,509 10	204,162 09	d 63,652 19

Report of Coal Transported over the Lehigh Canal

For the week ending May 3, 1873.

REGIONS SHIPPED FROM.	TIDE. tons. ct.	LOCAL. tons. ct.	TL WEEK tons cwt.	TL. DATE. tons. cwt.
Mauch Chunk Region	5,093 11	3,345 02	8,438 13	26,847 08
Mauch Chunk Region Hazardville				
Beaver Meadow Region	894 05	3,468 04	4,062 09	9,005 02
Mahanoy Region	95 07	378 02	473 09	1,212 15
Hazleton Region	2,005 05	5,959 00	7,964 05	24,510 12
Upper Lehigh Region		857 01	857 01	3,807 18
Wyoming Region	2,477 16	1,769 03	4,246 19	16,704 00
Wyoming Region, Hazardville				
Total	10,266 04	15,776 12	26,042 16	82,087 15
Previously reported	24,824 16	31,220 03	56,044 19	
Total to date	35,091 00	46,996 15	82,087 15	
Corresponding week last year	37,251 03	62,270 18	99,522 01	
Increase.				
Decrease	2,160 03	15,274 03	17,434 06	

DISTRIBUTION.	WEEK 1873.	WEEK 1872.	YEAR. 1873.	YEAR. 1872.
Consumed on line of Lehigh Canal	2,041 15	2,745 16	7,128 15	10,842 03
Passed into Morris Canal to Tidal Points	192 18	127 04	192 18	393 13
Passed into Morris Canal to Local Points	927 09	862 02	3,435 15	2,764 03
Passed into Del. & Rar. Canal to Tidal Points	10,073 06	9,027 07	32,782 09	36,857 10
Passed into Del & Rar. Canal to Local Points	756 06	739 10	1,703 12	3,109 09
Consumed on line Delaware Div. Canal	1 756 13	1,608 13	4,110 02	6,138 08
Passed through to Bristol	10,294 03	8,313 07	32,734 04	39,306 15
	26,042 16	23,420 19	83,087 15	99,522 01

Penn. and N. Y. R. R.—Coxton, Pa.

Coal tonnage for week ending May 17, 1873.

	Week. Tons.	Cwt.	Total. Tons.	Cwt.
Anthracite received:				
From Lehigh Valley R. R.	9,257 13		165,892 14	
" Lack. & B. R. R.	678 08		14,269 05	
" Pleasant Valley R. R.	4,188 08		73,302 02	
" Sul. & Erie R. R.	540 13		14,596 08	
Total	14,610 02		268,000 00	
Same time last year	12,708 19		248,951 16	
Increase	1,901 03		19,048 13	
Decrease				
Distributed:				
To Lehigh Valley R. R.	20 00		19,622 08	
To Lack. & B. R. R.	34 04		507 03	
To S. Central R. R.	5,289 16		57,221 14	
To Ithaca & A. R. R.	1,569 13		39,354 06	
To Erie R. W. Pockets for shipm't.	6,136 10		92,796 08	
To individuals on line of road	160 07		16,479 10	
To points at & above Coxton for use of Co	321 19		12,487 07	
To points between Waverley and Elmira	1,087 13		29,531 13	
Total	14,610 02		268,000 00	
Bituminous received from BARCLAY R. R.				
Shipped north from Towanda	7,185 17		125,695 10	
Shipped south from Towanda	....		783 13	
Northern Central R. R.	45 14		45 14	
Total	7,231 11		126,523 17	
Same time last year	2,205 09		142,317 09	
Increase	5,026 02			
Decrease	.....		15,793 12	
Distributed:				
To Erie Railway	6,658 06		108,105 05	
To So. Central R. R.	527 11		17,437 10	
To Ithaca Valley R. R.	....		117 00	
Lehigh Valley, R. R.	....		422 1	
To individuals on line of Railroad	45 14		322 06	
To points on line of road for use of Company	....		118 04	
Total	7,231 11		126,523 17	
Grand totals transported				
Anthracite	14,610 02		268 000 00	
Bituminous	7,231 11		126,523 17	
Total	21,841 13		394,524 06	
Same time last year	14,914 08		291,269 05	
Increase	6,927 05			
Decrease	.....		3,255 01	

Report of Coal Transported over Central R.R. of N. J. (Lehigh and Susq. Div.)

Week ending May 17—Compared with same time last year.

REGION SHIPPED FROM.	TIDE. tons ct.	LOCAL. tons ct.	CANAL. tons ct.	TL WEEK tons cwt.	TL. DATE tons.cwt.
Wyoming	28720 08	16196 11	4236 01	49153 00	665230 16
Upper Lehigh		2959 00	720 10	3679 10	74610 18
Beaver Meadow	1735 04	1779 08	2028 12	5543 12	71688 02
Hazleton			6194 13	6194 13	35439 09
Mauch Chunk	861 12	2463 00	8851 03	12175 15	171466 08
Total	31317 04	23397 17	22030 19	76746 10	1018425 13
Prev'ly reported	466843 02	394225 18	80620 03	941689 03	
Total to date	498160 06	417623 15	102651 02	1018435 13	
Same time 1872	418049 05	280828 13	73117 11	771995 09	
Increase	80111 01	136795 02	29533 11	246440 04	
Decrease					

DISTRIBUTION.	WEEK 1873.	WEEK 1872.	YEAR 1873	YEAR 1872.
Forwarded East by Rail to Tidal points	31317 04	30082 01	498160 06	418049 05
Forwarded East by Rail to Local points	7500 05	5863 18	178340 15	130443 01
Forwarded East by Rail use Central Division	2226 01	1616 02	34178 00	29937 00
Forwarded East by Rail use L. & S.	....	....		
Delivered at and above Mauch Chunk	1504 04	....	31048 19	20556 06
Delivered at Coalport & Hazard for Canal	22177 15	715760 19	127461 17	86633 17
Delivered to L. V. R. R. at Packerton	343 05		12902 09	6064 11
Delivered to L. V. R. Rd. at Sugar Notch	4874 18		39016 01	
Delivered to L. & B. R. R. at Plymouth Bridge	6537 10		92245 08	75615 02
Total	76746 10	60164 02	1018435 13	771995 09

Report of Coal Transported over Lehigh Valley Railroad

Report of coal tonnage for the week ending May 17, 1873, with totals to date, compared with same time last year.

WHERE SHIPPED FROM.	WEEK. Tons. Cwt.	TOTAL Tons. Cwt.
Total Wyoming	19,618 18	347,927 04
" Hazleton	42,598 05	834,325 06
" Upper Lehigh	....	1,809 18
" Beaver Meadow	16,357 08	278,306 09
" Mahanoy	7,136 04	176,869 14
" Mauch Chunk	86 03	1,969 03
Total	85,796 18	1,635,307 14
Same time last year	88,993 07	1,613,091 16
Increase		22,215 18
Decrease	3,196 09	
Forwarded East from Mauch Chunk by rail	64,693 11	1,330,426 17
Same time last year	69,554 14	1,342,243 07
Increase		11,816 10
Decrease	4,864 03	
DISTRIBUTED AS FOLLOWS.		
Local East of Mauch Chunk	1,241 13	38,310 08
Forwarded East for use L. V. R.	1,191 01	25,747 11
Delivered to Furnaces and Manufacturing Companies	13,502 02	321,230 01
Delivered to Cat & Fog. R. R.	133 17	2,600 05
" " East Penn R. R.	43 12	5,8-5 06
" " North Pennsylvania Railroad	5,602 00	148,840 00
" " Port Del.	10,746 03	42,030 00
" " East' Amboy Railroad	....	....
" " Morris and Essex Railroad	4,637 02	132,837 16
" " Bel Del Railroad	21,290 11	366,936 13
" " Central Railroad	6,3 2 08	241,978 17
Delivered at and above Mauch Chunk for use of L. V. R. R.	1,362 08	31,900 05
To P. & N. Y. R. R.	9,257 13	165,892 14
To Northern Central R. R.	525 01	5,471 12
To D. H. & W. R. R.	636 12	15,721 18
To L. & S. R. R. at Packerton for rail	276 14	6,064 04
To Individuals at Mauch Chunk	27 06	1,573 18
To Individuals above Mauch Chunk	200 10	7,734 14
To L. & S. R. R., at Penn Hav., for railroad		1,541 10
Do. for canal	6,242 03	30,754 15
To Lehigh Canal Mauch Chunk	2,563 02	8,716 07
To Catawissa Railroad	5 00	45 00
To L. & B. R.R. at Lack. Juno	76 18	29,466 00
Total	85,796 18	1,635,307 14

Statement of Coal Transported over Cumberland and Pennsylvania Railroad

During the week ending Saturday May 10, and during the year 1873, compared with the corresponding period of 1872.

WEEK.

	C. & O. C'l Tons. Cwt.	B. & O. R. R. Tons. Cwt.	Pa. S. Line Tons. Cwt.	Total. Tons. Cwt.
1873	21,326 14	23,770 11	1,143 06	52,240 11
1872	19,202 10	25,464 10	....	44,666 10
Increase	2,124 04	4,306 11	1,143 06	7,574 01
Decrease	.....	.....	.....	.....

YEAR.

1873	134,425 17	504,060 13	36,152 13	673,639 03
1872	156,059 18	440,166 01	....	596,228 19
Increase		63,891 12	36,152 13	77,410 04
Decrease	22,634 01	....	....	....

Cumberland Branch R. R.

WEEK.

	To C. & O. Canal. Tons. Cwt.	To P. & O. R. R. Co Tons. Cwt.	Total. Tons. Cwt.
1873	2,223 16	2,232 13	4,456 09
1872	5,367 14	467 02	5,834 16
Increase		1,765 11	
Decrease	3,143 18		1,378 07

YEAR.

1873	22,424 20	41,279 12	63,704 01
1872	51,076 11	4,298 16	55,075 07
Increase		36,280 16	7,628 14
Decrease	28,652 02		

Delaware and Hudson Canal Company.

Coal mined and forwarded by the Delaware and Hudson Canal Company for the week ending Saturday, May 17, 1873.

	WEEK.	SEASON
North	62,080 16	919,563 17
South	5,295 01	120,226 13
Total 1873	67,375 17	1,039,790 10
Corresponding time in 1872 :		
North	58,922 04	944,037 15
South	8,227 07	131 539 13
Total, 1872	63,149 14	1,075,577 08
Increase North		
Decrease North		
Increase South		
Decrease South		
Increase	226 06	
Decrease		35,786 18

Northern Central Railway, Shamokin Division.

Below is the return of Coal sent over the Shamokin Division o the N. C. R. W., for the 7 days ending May 16, 1873.

	Tons.	Cwt.
East	1,487 03	
West	12,206 08	
	13,693 11	
Same time last year	11,689 09	
Increase	2,004 02	
Decrease	....	....
Total amount shipped to date	193,512 18	
Same time last year	165,621 02	
Increase	27,891 16	
Decrease	....	....

Pennsylvania Coal Company.

Shipments of Pittston Coal for the week ending May 17, 1873.

	1873. WEEK.	1873. YEAR.	1872. WEEK.	1872. YEAR.
By Railway	32,641 07	375,101 06	25,693 09	424,0 0 19
" Canal	239 02	1,744 13	237 01	832 04
	32,880 20	370,845 19	25,936 13	423,253 03
Decrease 1873	46,407 04			

Delaware and Hudson Canal Company.

Coal mined and forwarded by the Delaware and Hudson Canal Company for the week ending Saturday, May 17, 1873.

	WEEK.	SEASON.
By Delaware and Hudson Canal	50,891	216,686
By Railroad, East	5,208	142,870
" West	9,695	161,579
" South	5,295	120,227
Total 1873	71,089	641,362
Corresponding time in 1872 :		
By Delaware and Hudson Canal	50,594	223,547
By Railroad, East	15, 80	246,224
" West	7,926	126,789
" South	8,227	131,540
Total	81,927	728,100
Decrease	56,735	

Delaware Lackawanna & Western Rail Road Company.

Coal transported on the Delaware, Lackawanna, & Western Railroad for the week ending Saturday, May 17, 1873.

	WEEK. Tons. Cwt.	YEAR. Tons. Cwt.
Shipped North	15,6 5 16	247,577 03
Shipped South	53,918 06	848,858 12
Total	69,583 12	1,076,354 09
For the Corresponding time last Year :		
Shipped North	16,241 01	215,060 10
Shipped South	43,653 04	765,805 05
Total	59,894 05	1,040,760 00
Increase	9,689 07	55,594 15
Decrease	.....	

Schuylkill Canal.

Report of coal transported over the Schuylkill Canal for the week ending Saturday, Mai 3, 1873.

	Tons. Cwt.
From Schuylkill Haven	20,376 00
" Port Clinton	953 00
Total for week	21,329 00
Previously this year	71,840 10
Total	94,169 10
To same time last year	153,181 09

Prices of Coal by the Cargo.

[CORRECTED WEEKLY.]

	AT NEW YORK. May 22. R. A.	W. A	AT PHILADELPHIA. May 22. R. A.	W. A.
SCHUYLKILL.				
Lump	$- —	$5 45	- —	4 10
Steamer	- —	5 45	- —	4 10
Broken	5 70	5 45	4 35	4 10
Egg	5 85	5 60	4 50	4 25
Stove	6 05	5 75	4 70	4 40
Chestnut	5 20	5 95	3 85	3 60
Pea	- —	- —	- —	- —
LEHIGH.				
Freight to New York 50 cents.				
Lump, (on board)	- —	5 35	- —	- —
Broken	- —	5 30	- —	- —
Egg	- —	5 30	- —	- —
Stove	- —	5 60	- —	- —
Chestnut	- —	4 35	- —	- —
Pea	- —	- —	- —	- —
SPECIAL COALS *				
Honey Brook, Le'h W. A.	4 70@5 60		- —	- —
Spring Mountain " "	- —@- —		- —	- —
Sugar Loaf " "	- —@- —		- —	- —
Room Run " "	4 70@5 60		- —	- —
Hill & Harris " "	4 70@5 60		- —	- —
Shamokin " "	4 70@5 60		- —	- —
Lykens Valley " "	4 85@6 10		- —	- —
Broad Top " "	6 60@- 10		5 35	- —

Company Coals.

May, 1873.

	L.	Str.	Ora.	Egg.	Sto.	Chest
*Scranton at E. Port	4 35	4 35	4 55	4 75	5 60	4 35
Pittston at Weehawken	4 80	4 80	4 80	5 00	5 50	4 70
*Lackawana at Weehawken	4 70	4 70	4 90	5 15	5 60	4 70
Wilk'b're at Hoboken	4 55	4 75	4 90	5 10	5 45	4 55
Old Co. Lehigh at Pt. John'n	5 60	—	5 35	5 35	5 50	4 70
New York Coal Exchange	5 35	—	5 20	5 20	5 35	4 65

For freights to different points see "Freights"
*To contractors only.

Prices at Baltimore—May, 1873.

Wholesale Prices to Trade.

Wilkesbarre, by cargo or car load	$5 75@6 00
Pittston and Plymouth, do	5 50@5 75
Shamokin Red or White Ash, do	5 50@5 75
*Lykens Valley Red Ash, do	....@5 80
By retail, all kinds per ton of 2,240 lbs	7 50@8 00
*George's Creek and Cumberland f. o. b. at Locust Point for cargoes	....@5 00
Fairmont and Clarksburg gas f. o. b. at L. Point	6 50
Kanawha Cannel, coarse	@12 00

* Freight to New York $2 15.

BITUMINOUS COALS.

Kittaning Coal Co.'s Phœnix Vein, f. o. b. at Phila	$
Lemon " " "	
Cumberland Vein Coal	....
Tyrconnel f. o. b.	$7 00

Prices at Georgetown, D.C., and Alexandria, Va.

May, 1873.

George's Creek and Cumberland f. o. b. for shipping $4 60@4 75

Prices at Havre de Grace, Md.

May, 1873.

Wilkesbarre and other White Ash for Cargoes	$ @....
Lykens Valley	@....
Shamokin Red or White Ash	....

Bituminous Coals (Cumberland).

Georgetown, F.o.b.	$4 60
Baltimore "	5 00
New York "	7 25
South Amboy "	6 75

Prices of Foreign Coals.

May, 1873.

Duty 75 c. per ton.

Corrected weekly by ALFRED FARMELE, No. 32 Pine street, N. Y.

Liverpool Gas Caking	— —@— —
" " Cannel	17 00@— —
" House "	22 00@23 00
" Orrel	19 00@— —

Per ton 2,240 lbs., ex-ship.

PRICES FROM YARD.

Liverpool House Orrel, screened	$20 00@22 00
"Cannel, "	23 00@25 00

Per ton 2,000 lbs. delivered.

Prices of Gas Coals.

May, 1873.

PROVINCIAL.

Corrected weekly by Louis J. Belloni, Jr., 41-43 Pine st., N. Y

	Coarse	Slack.
Block House	$2 50	$1 00
Gowrie	2 50	0 00

Corrected by Bird, Perkins & Job, 27 South street.

	Coarse.	Culm of Coal,
Pictou nett	$2 50	1 50
Sydney	2 50	1 00
Lingan	2 00	- 00
Caledonia	2 00	1 00

A discount from the prices of the coarse Coal on purchase of 5000 tons and upwards. Duty on all slack coal or Culm: 40c. per ton of 28 bushels, 80 pounds to the bushel. On all bituminous coal or shale: 75 cents per ton of 28 bushels.

AMERICAN.	Nominal quo Currency.
Westmoreland f. o. b.	$6 50 @7 00
Fairmount Gas Coal Co. of N. Y. "	6 50 @7 00
Despard Coal Co. "	6 50 @7 00
Penn. "	6 50 @7 00
Newburg Orrel Gas. "	6 50 @7 00
West Fairmount Gas Coal. "	6 50 @7 00
Redbank Cannel, Penn. "	6 50 @7 00
AT PHILADELPHIA.	
Westmoreland "	6 50 @7 00

Freights.—May, 1873.

TO EASTERN PORTS.	Cumberland. From Georgetown.	Cumberland. From Baltimore	Anthracite. From Phila'a.	Anthracite. From Elis. Port, Port Johnston, and Hoboken.	Anthracite. From Newburgh.	Anthracite. From Rondout.
Amesbury	3 75	—	—	—	—	—
Bangor	3 75	3 50	—	2 00	—	—
Bath	2 87	3 00	—	2 25	—	—
Boston	3 00	3 00	—	2 15	2 25	2 40
Bridgeport	2 50	3 00	—	1 00	—	1 20
Bristol	—	—	—	1 40	—	1 75
Cohasset Narrows	3 00	—	—	—	—	—
Derby	3 25	—	—	1 25	—	—
Dighton	2 65	—	—	—	—	—
East Cambridge	2 75	2 75	—	2 15	—	—
Fall River	2 75	2 75	—	1 40	1 60	1 75
Hackensack	—	3 00	—	—	—	—
Hartford	—	3 25	—	1 50	—	1 75
Hoboken	2 10	—	—	50	—	65
Jersey City	2 10	—	—	50	—	65
Lynn	—	—	—	—	—	—
Middletown	—	—	—	1 25	—	1 70
Mystic	—	—	—	1 25	—	1 55
New Bedford	3 00	3 10	—	1 40	—	1 90
Newburyport	3 12	3 00	—	2 35	—	2 55
New Haven	2 55	2 65	—	1 00	—	1 20
New London	2 75	2 60	—	1 20	1 40	1 45
Newport	—	2 65	—	1 40	—	1 75
New York	1 15	2 15	—	55	—	65
Norwalk	2 75	2 75	—	1 00	—	1 45
Norwich	2 60	2 75	—	1 30	1 50	1 55
Pawtucket	3 00	3 00	—	1 50	—	1 75
Portland	3 60	3 60	—	2 10	—	—
Portsmouth, N. H	3 00	3 60	—	2 25	—	2 55
Providence	2 75	2 7	—	1 40	1 65	1 75
Rockport	—	—	—	—	—	—
Saco	—	—	—	—	—	—
Sag Harbor	—	—	—	1 20	—	—
Salem	3 00	3 00	—	2 15	—	—
Stamford	—	—	—	1 00	1 20	—
Stonington	—	—	—	1 25	—	1 55
Taunton	—	—	—	1 90	—	—
Warren	—	—	—	1 40	—	—
TO RIVER PORTS						
Albany	—	—	—	—	—	55
Catskill	—	—	—	—	—	50
Cocksackie	—	—	—	—	—	60
Coeyman's	—	—	—	—	—	65
Cold Spring	—	—	—	—	—	20
Fishkill	—	—	—	—	—	20
Haverstraw	—	—	—	—	—	40
Hudson	2 50	—	—	—	—	40
New York vessels	2 00	—	—	—	—	65
Nyack	—	—	—	—	—	45
Poughkeepsie	—	—	—	—	—	30
Rhinebeck	—	—	—	—	—	30
Rondout	—	—	—	—	—	—
Saugerties	—	—	—	—	—	40
Sing Sing	—	—	—	—	—	50
Stuyvesant	—	—	—	—	—	55
Tarrytown	—	—	—	—	—	50
Troy	—	—	—	—	—	60
West Point	—	—	—	—	—	20
Youkers	—	—	—	—	—	50

* And Towing.

St. Thomas	$- — Gold
Martinique	- — "
Demerara	- — "
New Orleans	- — "
Mobile	- — "

Foreign and Provincial Freight

May, 1873.

Foreign.
Newcastle and Ports on Tyne, per keel of 21 1-5 tons £
Liverpool, 5 per cent primage

TO NEW YORK.

Provincial

Sydney	$3 50
Lingan	3 50
Cow Bay	3 50
Port Caledonia	3 50
Little Glace Bay	3 50

TO BOSTON.

Sydney	3 00
Lingan	3 00
Cow Bay	3 00
Port Caledonia	3 00
Little Glace Bay	2 90

Rates of Transportation to Tide Water.

BY RAILROAD.

TO PORT RICHMOND, PHILADELPHIA.

Philadelphia and Reading Railroad, from Schuylkill Haven Lump and St., net, $1 60; Br., Egg and Ch., $1 65; Stove, $1 75 Shipping at Pt. R., 20c., for use at Phil., $2 18 from Pt. Carbon.

MAUCH CHUNK TO ELIZABETHPORT.

L. V. Railroad from Mauch Chunk to Phillipsburgh	$0 72
C. R. R., N. J., Phillipsburgh to Elizabethport	66
Shipping expenses at Elizabethport	25
Wharfage	10
Total	$2 23

MAUCH CHUNK TO PORT JOHNSTON.	
L. V. R.R., or L. & S. R.R. from M. C. to Phillipsb'g	$0 72
C. R. R., of N. J., Phillipsburgh to Pt. Johnson	1 06
Shipping expenses	25
Wharfage	10
Total	$2 23
TO HOBOKEN	
L. V. R. R., Mauch Chunk to Phillipsburgh	72
Morris & Essex R. R. Phillipsburgh to Hoboken	1 06
Shipping expenses	25
Wharfage	00
Total	$2 23
TO SOUTH AMBOY.	
L. V. R. R.	72
B. & D. R. R. / Cam. & Am. R. R.	1
Shipping Expenses	35
Total	$2 23
PENN HAVEN TO ELIZABETHPORT.	
L. V. R.R. Penn Haven to Phillipsburgh	84
C. RR. of N. J. Phillipsburgh to Elizabethport	1 06
Shipping expenses	15
Wharfage	20
Total	$2 35

MARKET REVIEW.

NEW YORK, May 22, 1873.

IRON—Scotch Pig is now very quiet, the business being chiefly confined to small parcels for the immediate wants of consumers; the sales for the last two weeks will amount to, perhaps, 1500@2000 tons of all brands, most of which we have noticed in previous issues; the lowest prices reached, have, we believe, been $46 for Eglinton and $47 for Glengarnock, both ex ship, but these figures are now below the present asking prices; Glengarnock, as noticed in our last, is nearly out of stock, and with receipts likely to be light for some time to come, is held with more firmness, and may be quoted $50@$51 from yard; 300 tons sold on terms not transpired. American Pig is firm as usual, and the impression seems to be that prices are more likely to advance than to decline. As the season advances the production is likely to be curtailed, as the warm weather makes it difficult to push the furnaces to their full capacity. We hear of sales and resales of 500 tons No. 1 and 2 Crane & Thomas, on private terms. New Rails are without business. Old English have been in further demand, with sales of 1000 tons T. at $49@$50, time and interest, and 2000 do. D. H. and T., here and at Philadelphia at $50, and under. Scrap is dull; 125 tons coarse No. 1 sold, delivered at Jersey City, at a price equal to $48 from yard. Refined Bar continues quiet, and rather nominal, buyers of any considerable quantity being able to do $2.50 per ton better than our quotations.

COPPER—Manufactured is steady at our quoted rates. Ingot remains unusually quiet; Lake for immediate delivery may be quoted 32@32½ cents, and for the summer months 31@31½. In English we note sales of 75 tons B. S. at 30@30½ cents, 30 days.

LEAD—Foreign is quiet but firm at our quotations. In Domestic, we note the sale of 25 tons California at 5½ cents, gold. Bar, Pipe and Sheet are steady at our quotations.

Withdrawals from bond for consumption 16th, 17th and 19th May—

Lead, Spain ..... pigs. 313

SPELTER—The demand is very limited, the business being confined to small lots from store at 7¾@8 cents gold for Silesian; invoice lots cannot be quoted over 7½@7¾ cents gold.

STEEL—The market is strong at our quotations, with a small stock and light arrivals.

TIN—For Pig, there is no inquiry whatever, and prices are wholly nominal; holders are asking 32 cents for Straits, 31@31¼ for English, and 37½ for Banca, gold. Cable advices from London quote English L. and F. £145, and Straits £141 10s. The demand for Plates continue very limited, though prices are without further quotable change; we note sales of 350 bxs. Charcoal Tin at $11.75 for I. C.; 250 do. Charcoal Terne, $10.50 gold; 100 do., 20 by 28, and 500 do. Coke Tin, on terms not made public.

ZINC—Mosselmann Sheet is unchanged, the agent's price being 9½ cents, less 4 per cent. gold. Manganese black oxide 3½, do. peroxide gray 5½.

METALS.

NEW YORK, May 23, 1873.

IRON.—Duty: Bars, 1 to 1½ cents ℔ lb; Railroad, 70 cents ℔ 10 lbs.; Boiler and Plate, 1½ cents ℔ lb; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾ cents ℔ lb; Pig, $7 ℔ ton; Polished Sheet, 3 cts. ℔ lb; Galvanized 2½; Scrap Cast, $6; Scrap Wrought, $8 per ton. All less 10 per cent. No Bar Iron to pay a less duty than 35 per cent. ad val.

	Store Prices.
Pig, Scotch—Coltness ℔ ton	50 00@— —
Gartsherrie	— —@— —
Glengarnock	49 00@50 00
Eglinton	48 00@49 00
Pig, American, No. 1	49 00@50 00
Pig, American, No. 2	46 00@48 00
Pig, American, Forge	40 00@42 00
Bar Refined, English and American	110 00@— —
Bar Swedes, assorted sizes (gold	137 50@142 50
	Store Prices, Cash.
Bar, Swedes, 1¼ to 5 x ⅜ & ⅝ 2 sq. & 6 to 12 x ⅜ & ½	150 00@160 00
Bar, Refined, ¾ to 2 in. rd. & sq. 1 to 6 in. x ⅛ to 1 in.	— —@100 00
Bar, Refined, 1¼ to 6 by ¼	— —@105 00
Bar, Refined, 2¾ to 2¾ round 1 & 1¼ by ¼ & 5:16	— —@107 50
Large Rounds	110 00@120 00
Scroll	120 00@165 00
Ovals and half-round	125 00@145 00
Band	— —@117 50
Horse Shoe	— —@125 00
Rods, ¾ to 3-16inch	105 00@150 00
Hoop	125 00@172 50
Nailrod	6 45@ 6 60
Sheet, Russia, as to assortment (gold)	16 @ 17
Sheet, Singles, D. and T. Common	—6¼@— 7¼
Sheet, D. and T. Charcoal	—7¼@— 8½
Sheet, Galv'd, list 10 per cent, discount	—@— —
Rails, English (gold), ℔ ton	70 00@— —
Rails, American, at Works in Pennsylvania, currency	80 00@ 82 50

COPPER.—Duty: Pig, Bar, and Ingot, 5; old Copper 4 cents ℔ lb; Manufactured, 45 per cent. ad val.

	All Cash.
Copper, New Sheathing, ℔ lb	— @— 43
Copper Bolts	— @— 45
Copper Braziers, 16oz. and over	— @— 45
Copper Nails	— @— 45
Copper, Old Sheathing, &c. mixed lots	28 @— 30
Copper, Old, for chemical purposes, 14@16 oz	— @— 32½
Copper, American Ingot	30 @— 30½
Copper English Pig	— @— 30½
Yellow Metal, New Sheathing & Bronze	— @— 27
Yellow Metal Bolts	— @— 32
Yellow Metal Nails, Sheathing and Slat'g	27 @— 30

LEAD.—Duty: Pig, $2 ℔ 100 lbs.; old Lead, 1½ cents ℔ lb Pipe and Sheet, 2½ cents ℔ lb.

Galena, ℔ 100 lbs	$— — @— —
Spanish (gold)	6 75 @6 87½
German, do.	6 75 @6 87½
English do.	6 75 @7 00
Domestic do.	6 45 @6 60
Foreign, Refined	7 25 @7 50
Bar (net)	9 25 @— —
Pipe (net)	— — @10 50
Sheet	— — @10 50

STEEL.—Duty: Bars and ingots, valued at 7 cents ℔ lb or under 2¼ cents; over 7 cents and not above 11, 3 cents ℔ lb; over 11 cents, 3½ cents ℔ lb, and 10 ℔ cent ad val. Store prices.

English Cast (2d and 1st quality) ℔ lb	— 18½@— 23
English Spring (2d and 1st quality)	— 9½@— 10½
English Blister (2d and 1st quality)	— 14 @— 18½
English Machinery	— 14½@— —
English German (2d an 1st quality)	— 12½@— 14½
American Blister "Black Diamond"	— — @— 11½
American, Cast, Tool do.	— — @— 17
American, Spring, do.	— — @— 11
American Machinery do.	— 11½@— 12
American German, do	— 9 @— —

TIN.—Duty: Pig, Bars, and Blocks, 15 ℔ cent. ad val.; Plate and Sheets and Terne Plates, 25 ℔ cent.; Roofing 25. ad val.

	Gold ℔ lb.
Banca	— @37½
Straits	32 @—
English	31 @31¼

PLATES.

Fair to Good Brands.	*Gold.*	*Currency*
I. C. Charcoal, ℔ box	$11 50 @12 00	$13 75 @14 50
I. C. Coke	9 50 @10 50	11 37½@12 50
Coke Terne	8 87½@ 9 50	10 00 @11 25
Charcoal Terne	10 25 @11 00	12 25 @13 00

SPELTER—Duty: In Pigs, Bars & Plates, $1.50 p. 100lbs.

Plates, Foreign	(gold) p. 100 lb.	7 62½@—7 87½
Plates, Domestic	p. lb.	9 @—11

ZINC—Duty: Pig or Block, $1.50 per 100 lb.; Sheet 2½c. per lb.

Sheet	per lb.—10¼@11

San Francisco Stock Market.

BY TELEGRAPH.

NEW YORK, May 22, 1873.

The following report from the San Francisco Stock Board is dated the 20th inst. Without exception the market has declined, the decline having been general and uninterrupted during the operations of the week.

			May 22.
Savage	—	—	118
Crown Point	—	—	120
Yellow Jacket	—	—	77
Kentuck, "New Issue"	—	—	10¾
Chollar Potosi	—	—	65
Gould & Curry "New Issue"	—	—	13
Belcher "New Issue"	—	—	83
Imperial	—	—	7⅛
Raymond & Ely	—	—	56
Meadow Valley	—	—	21¾
Eureka G. V.	—	—	2½
Ophir	—	—	—
Hale and Norcross	—	—	—

American Institute of Mining Engineers.

OFFICIAL BULLETIN.

Announcements to Members and Associates.

I. All members and Associates who pay their dues ($10,) for each current year, strictly in advance, will have sent to their address, regularly and weekly, the ENGINEERING AND MINING JOURNAL, which is the organ of the Institute, and will contain the proceedings and transactions, and all important papers read before the Institute and all notices of meetings. Back numbers cannot, as a general rule, be sent.

Those members and associates who have not paid their dues for the current year, are requested to do so at once. Money may be sent in postal orders, checks or bank bills, to the Secretary, THOMAS M. DROWN, 1123 Girard street, Philadelphia, Pa.

II. It is expected that the more important papers, read before the Institute, and the debates thereon, will be published in annual or occasional volumes to which those Members and Associates will be entitled who have paid their dues.

III. All authors of papers are requested to notify the Secretary in advance of the meetings, giving the subject and length of their papers. Attention is also called, in this connection, to Rules 12 and 13.

IV. The ninth rule has been amended, so that there will be hereafter three meetings a year, in February, May and October.

THOMAS M. DROWN, Secretary.

1123 Girard street, Philadelphia, Pa.

A GENTLEMAN WITH A GOOD BUSINESS connection, of considerable commercial, mining, and mechanical experience, is about to return to England for a time, after a number of years' residence in the States, and would be glad to represent one or more American firms in either Liverpool, Manchester, or London. Highest references given to both American and English houses. Address,

Z. N. K., Office of this paper.

MISCELLANEOUS.

The Largest Organ Establishment in the World.

SEVEN EXTENSIVE FACTORIES.

J. ESTEY & COMPANY,

BRATTLEBORO, VT., U. S. A.

THE CELEBRATED

ESTEY COTTAGE ORGANS.

The Latest and Best Improvements.

Everything that is new and novel. The leading improvements in Organs were introduced first in this establishment.

ESTABLISHED 1846.

SEND FOR ILLUSTRATED CATALOGUE.

April 1:6m

114th Auction Sale.

80,000

TONS SCRANTON COAL.

On WEDNESDAY, MAY 28th, 1873.

NEW YORK, May 20, 1873.

The Delaware, Lackawanna and Western Railroad Company will sell, by MESSRS. JOHN H. DRAPER & CO., Auctioneers, at the Company's Sales Room, 26 EXCHANGE PLACE, corner of William Street, NEW YORK, on WEDNESDAY, MAY 28th, at 12 o'clock, noon,

80,000 TONS

OF

COAL, FROM THE LACKAWANNA REGIONS,

of the usual sizes, deliverable at the option of the Company at their Coal Docks either at Hoboken or Elizabethport during the month of June, 1873.

The sale will be positive; each lot put up will be sold to the highest bidder; no bids, in any form whatever, being made for account of, or on behalf of the Company. The conditions will be fully made known at the time of sale.

TERMS: FIFTY CENTS PER TON, payable in current funds, on the day of sale, and the balance, within ten days thereafter, if required, at the office of the Company.

SAMUEL SLOAN, President.

To INVENTORS AND MANUFACTURERS

The Managers of the 42d Exhibition of the American Institute, of the City of New York, beg to announce, that the Exhibition Buildings on 2d and 3d Avenues and 63d and 64th Streets, will be open for the reception of heavy Machinery August 18th and for other articles, September 1st 1873. The Exhibition will be formally opened September 10th.

For particulars, address "General Superintendent, American Institute, New York."

May 27-tf

WM. A. SWEET, Pres't. GEO. W. HARWOOD, Treas. FRED. B. CHAPMAN, Sec'y.

SWEET'S MANUFACTURING CO.,

SYRACUSE, N. Y.,

MANIPULATORS OF

Bessemer Steel,
Siemens Martin Steel,
Cast Steel,
Blister Steel.

MANUFACTURERS OF

Sweet's Cast Steel Crow Bars,
Sweet's Cast Steel R. R. Bars,
Sweet's Oil-tempered Seat Springs,
Sweet's Excelsior Steel Tire,
Swede's Spring Steel,
Cast Spring Steel,
English Spring Steel,
Sleigh Shoe Steel,
Cutter Shoe Steel,
Frog Point Steel.

Nov. 19:1y

THE ENGINEERING AND MINING JOURNAL.

ROSSITER W. RAYMOND, Ph. D.
JOHN A. CHURCH, E. M. Editors.

PUBLISHERS' ANNOUNCEMENT.

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So far as the formal sessions of the Philadelphia meeting of the American Institute were concerned, the meeting was evidently a success. The attendance of leading members was good; the papers and discussions were highly interesting; the election of new officers passed off satisfactorily; and the new rules adopted by the Institute will be universally recognized as an improvement upon the hasty compilation which has hitherto been the somewhat blind guide of our operations. The Institute voted to hold its next meeting at Easton, Pa., at the time of the inauguration of the new and beautiful edifice of the Pardee Scientific Department of Lafayette College. Another incident of much significance was the passage of a resolution, inviting the Iron and Steel Institute of Great Britain to hold a meeting in this country in 1874—an invitation which we have reason to believe, will be accepted in a spirit of cordial fellowship, and will lead to a gathering of unprecedented interest. Nothing but good can come of such an exchange of experience and opinion as will thus be brought about. We shall welcome such guests as BESSEMER, SIEMENS and BELL with unfeigned pleasure.

Of the grand three days' excursion to Reading, Pottsville, Cornwall, etc., with which the Philadelphia meeting concluded, we have received, up to the hour of going to press, no report. But of course it was delightful.

IT is a pleasure to record the triumphs of any sensible and popular mode of distributing the favors which government has to bestow. Of this kind the competitive examination by which General SICKLES, when in Congress, selected his candidates for West Point, appears to be one. The victor in the examination was a young man named GARRET J. LEYDECKER, son of a Deputy collector of New York. He went to West Point, graduated at the head of his class in 1863, and was at once made First Lieutenant of Engineers and assigned to General MEADE's staff. He has served in New York harbor, made a survey of the great lakes, and taught engineering at West Point since his graduation and before he was detailed to join General SCHOFIELD's command. Captain LEYDECKER is twenty-nine years old. His last work was the dangerous task of making a photographic survey of the Lava Beds in the face of Captain JACK and his braves.

Mr. Van Buren's Defence.

THE late American Commissioner at Vienna, Mr. THOMAS VAN BUREN, may or may not have been guilty of personal corruption in the management of the work entrusted to him; but one thing is certain: he has demonstrated his utter incapacity to comprehend the duties and the proprieties of his position. When suspended for alleged misconduct, he wrote to the Vienna newspapers, not only denying the charges against him, but claiming that he had accomplished wonders in the discharge of his duty, without any aid from his government. This fling at the government, though deserved by the dilatory folly of Congress, was obviously out of place on the lips of the representative of America at Vienna. The utterance of it should have cost Mr. VAN BUREN his place, though he were as pure as an angel.

But this indecency was followed by that of writing to the President and the Secretary of State letters which are too furious and too absurd for slander, and must be set down as the malignant ravings of a maniac. They would be wicked, if they were not so foolish. In them he accuses Minister JAY, Mr. THOMAS MCELRATH, and everybody connected with his downfall (except the rogues who really caused it) of the vilest conspiracy and treachery. Mr. JAY, in particular, was jealous of his great success, and anxious to take from him the glory of his position! This accusation betrays how totally Mr. VAN BUREN misunderstood his position from the first. He thought that getting a heap of goods together, without order or system, was "success;" he boasted of the manner in which he had accomplished his work, when the real work had not been begun; and dreamed that instead of attending to his business, like a mere supercargo, as he was, his function would be to swell about as a Plenipotentiary, before whose "glory" the mere Ambassadors of the United States should grow green with envy.

Most ridiculous of all is the crazy allusion that he makes to Professor WM. P. BLAKE. This gentleman also, it seems, was envious of the VAN BUREN glory, and was willing to "play jackal," that is, examine witnesses, for the new commission of the conspirators, in order to get another job like the one he had in editing the reports of the Paris Exposition! We can fancy the amusement of Professor BLAKE at this proposition. We happen to know what sort of a job the editing of the Paris reports involved; and we are safe in saying that the distinguished editor does not want another like it! But even more ridiculous is the new illustration of Mr. VAN BUREN's morbid conceit of his own importance, which this malignant slander affords.

Professor BLAKE is at present at Vienna, as the Executive Commissioner of the Centennial at Philadelphia—a position higher than Mr. VAN BUREN's. It is fortunate, indeed, for the United States that he arrived in Vienna at a time when the presence of an expert was so sorely needed. No one is so specially well qualified as he, to bring order out of chaos, and to redeem what can yet be redeemed in the American department. His experience of two World's Fairs, and the labor he has just completed in arranging the classification for the Centennial, make him exactly the man required. Under these circumstances, it is not surprising that Mr. JAY has pressed him into service; and it would have been less than patriotic in him to decline.

In a private note, recently received from Professor BLAKE, he expresses much sympathy for Mr. VAN BUREN's painful position, and makes no mention of the charges affecting the personal honor of the late Commissioner; but the facts he briefly communicates speak volumes as to the blind and reckless character of the management of affairs. No catalogue; no immediate hope of any; shiftlessness and confusion beyond description; the official Austrian catalogue gone to press with blank pages to represent the American department—these are hints from which the conclusions are inevitable. This is the "glory" which Mr. VAN BUREN professes to believe so dazzling as to rouse the jealousy of all beholders! It is surprising that he does not ascribe his removal by President GRANT to the same feeling.

But no; it is ingratitude of which he accuses the President. He cannot believe that GRANT would remove a man who had done so much to aid his election! If this disgraceful affair should open the eyes of the President to the danger of appointing politicians to places that require ability and experience, it would not be altogether in vain. The promptness and firmness of the government in this matter have done much to atone for its disastrous blunder at the beginning.

With regard to the Commissioners appointed by Mr. VAN BUREN, some of whom have certainly been guilty of outrageous rascality, it will be instructing hereafter to learn how they got their places. All but one, he says, were personally strangers to him, and were strongly recommended. Let us have the names of the sponsors. They will give fresh commentary on the value of the recommendations of politicians.

The Modes of Steel Making.

Probably no inventor is received with less favor by practical men than he who has a new steel process. Of the men who come to maturity (we mean 21 years), every year, a very large number are informed that steel is, in composition, intermediate between wrought iron and pig iron. Upon a certain proportion of these gentlemen the information acts like an electric shock, and the result is a perpetual stream of travellers to Washington, half of whom are rushing to take out a patent for making steel by the novel method of melting iron in presence of charcoal powder in a closed pot. The other half are still shrewder and aim, by a triumphant application of scientific acumen to the industrial processes, to make steel by simply removing the carbon from cast iron. The Commissioner of Patents receives all with benignity, hands over every year numerous rights to the exclusive manufacture of steel by one or the other of the above methods, and receives the proper fees. We contemplate the fee part of the business with unalloyed satisfaction, for it is the only solid advantage that accrues to any body in the whole round.

Of the two classes of original thinkers which we have described, the pig iron

men are usually classed as the most rational, and the wrought iron men the most practical; but there are reasons for saying that the pig iron men are the least rational as well the least practical. *A priori* the making of steel by removing carbon from cast-iron is the most rational way, because it is the most direct; but a trial shows us at once that directness is not the only premise which must be regarded. There are two other things which go to the making of steel. One is purity of product and the other is equality of "temper." A pure product is only to be had by using a pure pig, and as this article is not always obtainable, that process is, generally speaking, more rational which introduces some purifying operation—like the conversion of cast iron to wrought. As to equality of temper, that depends upon the amount of carbon left in the steel (neglecting other elements). Here again repeated trials have shown that it is very difficult to hit the exact amount of carbon in every operation when oxidizing agents are used, and a large proportion of past failures have been due to this difficulty. So that after all the direct conversion of cast iron into steel is not the most rational mode because it leaves two important requirements unregarded. On the other hand, wrought iron being a purified product, of a tolerably definite composition, satisfies these requirements, and may therefore rationally be used for steel making. In practice we find both these kinds of iron used together. In such cases the wrought iron must be considered as the leading raw material, while the cast iron is a carbonizer.

Although the above may read somewhat like the first chapters in an Elementary School Rhetoric, it is a statement of facts which may have its use. The old idea that the direct conversion of pig metal into steel is the only rational process, has cost inventors untold agonies of mental activity, and capitalists have suffered quite as much in pocket on account of it. The proof that the idea was wrong, is to be found in the constant abandonment of the process in steel making of every kind. Crucible steel, furnace steel, and Bessemer steel making processes are now in most cases, founded upon the principle of using wrought iron as a basis and either carbon or pig metal as a carbonizer.

When, therefore, Dr. SIEMENS says, that it is only lately that he has turned his attention to making iron from the ore, his previous efforts, lasting for some years, having been devoted to the manufacture of *steel* by melting iron ore in a rotary furnace, and reducing the metal by means of carbon thrown upon the bath, he makes a point that is worthy of attention. We would like to hear from the Doctor what means he employs to obtain the exact degree of carbonization required. Steel is an article the composition of which is fixed within narrow bounds by the extreme susceptibility of iron to the action of carbon. A variation of a quarter of a per cent. will run the grade up or down one number, and we fear that few manufacturers would hope to succeed in keeping within such close limits when the operation is to be performed in a revolving furnace. It must be remembered that it is upon just this point that puddling has failed for steel making, and that even the much more exact method of BESSEMER has been established upon the basis of the manufacture of iron, with subsequent re-carbonization, to produce steel. It is just this difficulty that made steel-making in reverberatory furnaces impracticable until the invention of the regenerative furnace.

We should be extremely well pleased to see the direct manufacture of steel from the ore a success; but when such a success is announced we look to see the points in which the new process differs from the old ones explained, and this explanation must relate to the points in which the old have proved faulty, or we cannot give it our unhesitating adhesion.

CORRESPONDENCE.

[From our Special Correspondent.]

LONDON, May 3, 1873.]

TO THE EDITOR:

SIR—The second day's meeting of the Iron and Steel Institute was held on Wednesday, April 29. Before the business of reading papers was commenced the President announced that Mr. BESSEMER had intimated to the Council his intention of placing in their hands a sum of money, the interest of which should be devoted to the periodical presentation of a gold medal to the one who should make the most valuable researches in metallurgy, or give to the Institute the most meritorious literary production in connection with the subject. The medal may be presented to members or non-members, at the option of the Council. This additional evidence of the practical interest which Mr. BESSEMER takes in the welfare of the Institute was received by the audience with the heartiest applause.

The entire session was occupied in the reading and discussion of Dr. SIEMENS' paper on the "*Manufacture of Iron and Steel by Direct Process*," of which the following is an abstract: [Although this paper follows so close upon what we published last week, we think the attention which this process is receiving in England is sufficient warrant for adding the following to what has been already given.—ED.]

Dr. SIEMENS, in the year 1868, constructed at Landore a rotative furnace, for the reduction of iron ore into sponge, which was attached to an open hearth steel-melting furnace, where the reduced material was converted into steel by its fusion in a bath of cast-iron; now, however, he effects the whole operation in the rotative furnace itself.

This rotative furnace is arranged as a regenerative gas furnace, in which air, intensely heated by means of regenerators, is introduced, in order to consume (immediately above the charge) the carbonic oxide, which is formed at a certain stage of the process, through the re-action of the oxygen of the ore upon the carbon mingled with it. By this means, the waste of carbonic oxide, which occurs in the blast furnace, is avoided.

As at present constructed, the rotator measures 7 feet diameter by 8 feet 6 inches in length, is mounted upon anti-friction rollers, and is provided with gearing through which quick and slow motion can be communicated to it at will.

The rotator is closed by a swinging door at one end, is constructed partly of cast and partly of wrought iron, and is lined with bricks made from calcined bauxite, a mineral peculiarly adapted by its refractory nature to resist the action of the scoria and the high temperature required. Having been previously heated, it is then charged with about a ton and a half of iron ore, with the necessary fluxes, or admixture of other ores to form a liquid slag under the influence of heat, is thereupon set in motion, and, an intense flame being directed into it, in order to heat the ore thoroughly, carbon for deoxidation is introduced, when the ore is on the point of melting. Under these conditions, the metallic iron is soon precipitated from the molten ore, on which the slag is tapped off, and a greater speed of motion than before is given to the rotator to ball up the iron. A charge of 15 cwt. of wrought iron may be thus made in rather less than three hours with a consumption of 25 cwt. of coal to the ton of metal produced, which is about one-half of the weight of coal required for making a ton of pig iron in a blast furnace.

Hitherto Dr. SIEMENS has confined his attention chiefly to the production of steel by this process, and in this he has been thoroughly successful, producing by such means a steel of superior quality, equal to crucible steel. He is now devoting himself to the production of wrought iron, and an important feature of this process is the purity of the metal produced, notwithstanding the presence of objectionable matter in the materials employed. Thus, although coal containing on an average 8 per cent. of sulphur was used for admixture with the ores under treatment, the metal obtained, as was shown by the tables of analyses, did not contain above ·013 per cent. of sulphur, when ores free from that impurity were employed, and metal made principally from Cleveland ore was obtained with at most ·176 per cent. of phosphorus.

Samples were shown of both iron and steel, giving evidence of the high quality of the metal producible, made by Messrs. VICKERS and Co., Sheffield; the Sample Steel Works, Birmingham; and the Landore Steel Company, Swansea. The last-named works, which were established when the scrap and ore process were in their infancy, are now producing 1,000 tons of steel per week.

Dr. SIEMENS has made many experiments with different mixtures for fire-proof bricks. One of the best mixtures was found to be pure quartz rock with 2 per cent. of quick lime and sufficient clay to bind. Another mixture was bauxite and 6 per cent. graphite. A compound brick was made, half the section being of the last named mixture, and half the regular Stourbridge brick. After two weeks' exposure to the intense heat of the Siemens furnace the bauxite part of the brick was only worn down half an inch, while the Stonebridge part was only half an inch in thickness. The original thickness of the compound brick was six inches. Dr. SIEMENS also called attention to the removal of sulphur by means of manganese in the blast furnace, in proof of which he pointed to the absence of sulphur in all analyses of spiegel iron. The paper was illustrated by elaborate and well executed wall drawings.

Col. CLAY bore testimony to the value of the process, and stated that his uncle, many years ago, had produced iron in a similar manner on a commercial scale.

Mr. SNELUS stated that one cause of the success of the process lay in the fact that the ores were treated in a *fluid* condition instead of a solid condition; he also said that Mr. JONES at Middlesb'ro had forced carbonic oxide through molten sesquioxide of iron and precipitated metallic iron thereby. How far he had progressed with his experiments he was not able to state. He added that he had used ground limestone *alone* in the Bessemer converter and had found it to stand well as long as the converter was kept hot. He believed that bauxite of the composition mentioned by Mr. SIEMENS would be found too expensive.

Mr. SNELUS claimed that manganese was not a necessary element in steel. Mr. RILEY asserted that it was. This question gave rise to a great deal of discussion and was not definitely decided. The action of copper when present in iron and steel was also warmly discussed.

Mr. BESSEMER observed that some years ago he was engaged in a series of experiments with the object of producing iron and steel direct from the ore in a manner similar to Dr. SIEMENS, but illness obliged him to abandon the work. He only referred to the matter now as a simple statement of fact, having no desire to detract from Dr. SIEMENS' merits. He congratulated Dr. SIEMENS upon his success and expressed a very high opinion of his invention. Messrs. MENELAUS, FOTHERGILL, COWPER, and others joined in the discussion. Mr. BELL complimented Dr. SIEMENS for setting the highest grade of perfection as the mark up to which he was trying to work, and said that only by such a standard could we hope to arrive at that success in science and practice, which we all so much desire to attain. Exact science sets the limit beyond which we cannot go, this was beautifully and forcibly illustrated by the well-known chemical fact that only 49 pounds of sulphuric acid can be made from 16 pounds of sulphur; were this theoretic extreme not known the sulphuric acid manufacturers might have expended large sums of money in an endeavor to make 50 pounds of acid from the 16 pounds of sulphur. This is an illustration of what the rule of thumb way of working too often leads the unscientific practical man to try to accomplish. Mr. BELL further said that although Dr. SIEMENS' invention was one of the first importance, its success had not yet been demonstrated to his entire satisfaction. He anticipated that some dificulties would yet be found to attend the

process of direct conversion, and would arise from the reoxidation of the reduced iron by carbonic acid, and also in dealing with the slag in the case of poor ores.

Dr. SIEMENS answered many of the objection at considerable length. He showed that he obtained complete combustion, and that the carbonic oxide which was lost in the blast furnace was consumed in his furnace under the most favorable conditions. He stated that he had already produced iron of the most approved quality which had stood very high tests, and he reiterated his firm conviction that he could and would manufacture iron on a commercial scale with the expenditure of only 1¼ ton of coal to the ton of iron produced. If Dr. SIEMENS' process turns out to be what he claims for it, its introduction into the United States will be assured, for our very rich magnetites and specular ores will be far better adapted for his purposes than those that he has had to use here. The day's proceedings were most fittingly brought to a close by a grand banquet at the celebrated Ship Tavern at Greenwich where the "feast of reason andflow of soul" was right up to the mark.

It will be gratifying to the members of our American Institute of Mining Engineers to know that their representative at this meeting was, in honor of their work, received in a most distinguished manner. In nearly all of the speeches very kind and complimentary expressions were used in reference to the wonderful development of the iron resources of the United States, and especially in reference to the good work which the American engineers are doing.

Mr. TUCKERMAN—our late minister to Greece—was present at the dinner and was one of those who replied for the Americans. His remarks were excellent and elicited great applause. M.

Method for the Manufacture of Cast Iron, Wrought Iron, and Steel.

BY ALOIS THOMA.

STEEL, and particularly cast-steel, at a low price, is one of the great wants of the present time. Untempered steel is very desirable not only for machinery and building, on account of its strength, but it possesses also other peculiarities, which give it especial advantages, whenever the price is such as to permit its extended introduction.

For example, whereas under repeated blows or bendings the fibrous and grained texture of iron and also of puddled steel becomes scaled and crystalline, thereby losing its strength, the cast-steel undergoes no change from vibrations, retains strength and all other good qualities. Had not the high price of its production been the hindrance, it would long ago have been used entirely for rails on account of the above mentioned qualities and durability.

By means of the introduction of the Bessemer process, the steel of which can only exceptionally be used for tools, and in reality is no steel at all, the price has been much reduced, not so much however as to come very near that of iron.

By it, however, useful articles can only be made by using a pale gray pig iron, free from sulphur and phosphorus, and not from the cheaper white iron. It is not possible to fit those kinds which contain sulphur, phosphorus and silicium for the Bessemer process by purification, for by so doing they become white. In England, where this method is in use, they import the necessary iron from Sweden or Westphalia, the little suitable quality made in England being sold at the same price as the imported article.

This process has many defects, amongst which those first to be mentioned are the uncertainty of making steel of any required texture, and a property which I might call, for want of a better word, an unripeness. Furthermore, experience shows that the rails made in this way are easily broken in the cold which cannot be the case with untempered cast-steel.

Seldom has a new method been built up with such an outlay of money and intelligence as Bessemer's. It has now been in use at some works many years. If under such circumstances it is still so incomplete, there is but little reason to believe that it ever will be perfected in these respects.

If cast-steel is to take the place of iron under all circumstances, particularly for rails, and sills, in ship building and machinery, for boilers and in agricultural implements, then it must be made cheap without impairing its quality. This can only happen when it can be made:

1st. Out of any pig iron, that is. from the poorer qualities or those containing sulphur, phosphorus or silicium;

2nd. With all kinds of fuel, and an economical use of the same;

3d. In simple, cheap and durable apparatus;

4th. Always with certainty of producing a good quality and of any required texture;

5th. With a minimum loss and waste;

6th. By a method permitting the production of the largest required pieces without difficulty, since such work is the most remunerative;

7th. Without necessarily requiring workmen of extra skill, strength or intelligence. It is very necessary that workmen should be taught without too much trouble.

I believe that not the low price of manufacture only, but principally the quality of the cast steel produced and the great certainty of the results will give general introduction to my method.

The consumption of fuel is very small. Whereas in England and on the continent of Europe (except in Sweden) 2000 lb. of coal, 200 lb. of coke and 2500 lb. of the *best gray iron* are used in the Bessemer works, my method requires 1590 lb. coal or a corresponding amount of wood, peat or lignite and 2340 lb. of *white iron.*

My method is divisible into two separate operations: 1st, Changing the pig iron to raw steel, and 2d, smelting the *raw steel* so-called to cast-steel. BESSEMER has also, according to the practice in England and here, two operations. 1st, the smelting of the pig iron in cupolas, and 2d, the conversion of the same into steel. To this is to be added the smelting of the spiegeleisen.

The de-carbonization of pig iron or changing the same to "material" or raw steel. In a shaft-furnace filled with pieces of pig iron I burn gases, made from any kind of fuel, mixed with water gas—that is, steam heated to a high degree. The steam is generated without the use of a boiler.

The pieces of pig iron under this glowing heat of mixed gases are

1st, Raised to a temperature of 1600° Fahr., and

2nd, At the same time changed to steel, *without having been in any way altered in outward form.*

This change of the pig iron to steel takes place *in a very simple manner with cheap agents, and with great economy of labor and fuel.* Besides this the *furnace is cheaply erected and durable, and the capacity is large.*

The working of the furnace is *continuous*, and the daily production 5—8 tons.

Although the exterior of the pig iron during the change to steel has not been altered, the alteration of the interior has been so much the greater.

The pig iron has acquired a steel fracture, and all the characteristics of steel. It can be tempered and worked. By long continued de-carbonizing, a coating is formed around a steel kernel or center, which is made thicker and thicker the softer you wish to make the steel.

THE SMELTING OF THE RAW STEEL.

In order to make cast-steel of every grade, that is, soft or hard, as may be required, and of any size of pieces, uniform and of the best quality, I melt the "material" steel, not in crucibles, as is generally practiced, but upon an *open pan. This forms the hearth of a gas reverberatory,* with a low arch, and can very easily be removed by lowering it. By this arrangement the cost of the vessel or apparatus is lessened about 90 per cent., and the smelting is simplified and made easy for the workmen. The melting is done with great certainty of result, with the use of any fuel, and with great economy. For example, in using wood the cost would be $1.20–$1.90, whereas by other methods the cost of coke or pure anthracite would be $12–$15. Besides, I can use at this work unskilled workmen.

Only with gas-fuel, and a suitably-constructed furnace, such as mine, can a good result be obtained by this process, *because only in this way can the intensity, character, and continued regularity of the flame be controlled or maintained, and the heat be directed to each part as may be required.* In this manner the proper heat *(with fluctuations, however,)* is maintained in the SIEMENS' furnace. It, however, has the unavoidable fault that the flame strikes more to the arch, leaving the hearth cooler, and therefore, aside from other troubles, is not suited for smelting steel without the use of crucibles.

The material-steel (previously brought to a red heat) is first introduced into the hearth (the harder variety at first, according to the quality of the steel desired) and covered with a layer of broken glass, or with neutral flux. This glass cover, which is soon melted, protects it from any influence or action from the gas-flame, and prevents any injury to the walls of the furnace from the steel.

When this steel shall have melted, the rest of the charge (1¼ to 2 tons) having been previously brought to a lively red heat, is introduced upon the hearth and spread evenly upon the first. This should be divided into two lots, and not all introduced at one time. When this last has been melted—which takes place very quickly—re-agents are introduced under the glass covering, and, after a light stirring, are left to act upon the steel. A test piece is taken then from this to ascertain the quality of the steel—something that cannot be done with crucible steel. If the test is satisfactory, it is tapped into a fire-clay lined ladle and poured into the moulds. If the test is not satisfactory, pig iron, bar iron, or reduced ore, is introduced, according to requirement.

The daily capacity of such a furnace is 5–8 tons, according to its size.

The further working of the cast steel differs from the present practice only in that I use gas furnaces for heating the large castings. *Cast steel produced in this manner retains, by further working, its steely nature.*

In the following figures I give the costs, from my own experience, of producing one ton of cast steel rails by this method from prepared pig iron, the price of pig iron being $22 per ton:

PRODUCTION OF MATERIAL, OR RAW STEEL.

2140 lb. pig iron @ $22 per ton	$23 50
700 lb. anthracite @ $5 per ton	1 75
Wages	1 60
Contingencies	1 20
One ton raw steel	$28 05

MELTING OF THE RAW STEEL.

2140 lb. of the above raw steel	$30 01
840 lb. anthracite	2 10
Re-agents	1 50
Wages	4 00
Contingencies	3 00
	$40 61
Further working necessary to produce one ton rails	20 00
Cost of one ton of rails	60 61

TO PURIFY IMPURE PIG IRON FOR THE PURPOSES OF CAST-STEEL MANUFACTURE.

If the pig irons to be used in the manufacture of cast steel by my process contain sulphur, phosphorus, or silicium, they should first be purified, in order to

obtain a steel of good quality. For this purpose, also, I employ a gas-furnace, in which fuel of any kind can be used with equal results.

By this purification the cost of the steel is not increased, because a lower-priced pig iron is used, which offsets the cost of the purification.

The daily product of a purifying furnace is five tons of pig iron, free from sulphur, phosphorus, and silicium, and *containing onlythe carbon, chemically combined.* The loss is 5-8 per cent. daily consumption of coal, about 5000 lb., or 2½ cords of wood. Wages, $1 75 per ton; contingencies, $1 20; necessary re-agents, $1 50.

The purifying furnace can also be used to make a very strong iron, suitable for rolls, cannon, bridge irons, etc., and in general for melting and refining metals.

PRODUCTION OF CAST STEEL FROM PIG IRON AND REDUCED ORES.

Where at least enough pure and rich ore can be had to answer as a mixture with the pig iron to be used for making cast steel, it will be well to produce it in this way, because the process is simpler and cheaper. *In this manner pig iron of any quality can be used also,* only the pig iron, containing impurities, or those kinds which do not contain the carbon united with the iron, should first be purified in the manner given above, and if possible it should be in the condition of a sponge.

Nevertheless, the white fibrous iron can easily be used. In all cases white pig, that is the cheapest sorts, must be employed ; and such iron of good quality and uniform percentage of carbon is easily made by my method of producing pig iron. In such case, that is, if the pig iron is made by my method, it can be run directly from the furnace into the steel furnace, a point of great importance, if works are to be carried on upon a large scale.

When the iron, from which steel is to be made, is fluid in the hearth or pan, the reduced or carbonized ore which has been previously heated in the hinder part of the furnace, is added in two or three portions, being each time thoroughly stirred or worked. I need not mention that the glass covering is also necessary here.

The mass becomes less fluid by the introduction of the ore, and must again be made fluid, before any more of the charge is added. If this is the case after the last of the charge has been added, then the change of the pig-iron to steel has taken place. Reagents or fluxes are then added as in the case of the raw-steel, and after they have acted upon the mass tests are made, and, if satisfactory, the tapping of the metal follows.

If the pig-iron and ores used were pure, a point that is sure if full use of my method is made, then the cast-steel is good and suitable for every purpose.

If we use for this process white iron containing 3 per cent. of carbon—sponge being the most suitable—and wish to obtain a steel containing 0.6 per cent. of carbon, then 2.4 per cent. of it must be removed from the pig-iron. In order to accomplish this, about 25 parts of prepared ore would be added to 100 parts of pig ; and the result would be about 110 parts of casting—allowance being made for loss by burning.

Produced in this manner, that is from pig-iron and prepared ores, the cost of one ton of cast steel made in Michigan from sand ores, and at present wages, there, would be as follows :

1820 lb. pig-iron, @ $22 per ton	$20 00
500 lb. reduced ores, @ $10.88 per ton	2 73
65 cb. ft. of wood @ 3¼ cents	2 11
Fluxes	1 50
Wages $5 00 ; contingencies $3 75	8 75
	$35 11
For further working the same	20 00
	$55 11

It is not necessary after these figures to show further the importance of this process. According to the above, the cost of the finished rails is little more than the cost price of the pig metal for the Bessemer process. It should be added that the foregoing estimates and the substance of this article, were prepared in May 1871, since which time the prices of some things have changed, without, as I believe, affecting the relative economy and importance of my process.

English Notes.

THE activity in the north of England ironmaking districts is seen in the fact that altogether about twenty-two new blast furnaces are either now building or projected. The Tees Bridge Iron Company, a new venture, have just blown in two furnaces, and propose to commence immediately with the erection of another two. Messrs. BELL BROTHERS, of the Port Clarence Iron Works, have laid the foundations of two furnaces, each eighty-five feet in height, and it is their intention to proceed with the erection of another six, giving them a total of sixteen furnaces in all. When these furnaces are completed the Port Clarence Works will be the largest works of their kind in the North of England, and with the single exception of Dowlais, the largest in the world. Messrs. WHITWELL & Co,, of South Stockton, have also completed two new blast furnaces, and so also have Messrs. DOWNEY & Co., of the Chatham Iron Works. Each of these new furnaces, when put in blast, will add from 400 to 500 tons a week to the manufacture of crude iron in the district. It is a question, however, whether this increased make will lessen prices, for the cost of materials is so high as to govern the market without much regard to demand. Coal and coke merchants are reported to have their hands pretty full ; and there is little appearance as yet of any accumulation of stocks at the pit mouth. Prices are firm. Coal for manufacturing purposes may be purchased in the open market at 18s. per ton ; but for household use from 5s. to 6s. more is asked. Coke still fetches 45s. at the ovens, and is in much request. Many new pits are being opened out in Durham and Northumberland, so that there is every likelihood of the present out-put being before long highly supplemented. This may have some effect, for Mr. BELL estimates that an increase of only 5 per cent. on last year's production would have prevented the high prices.

Hydrogen for Street Gas.

THE *American Chemist* disposes somewhat brusquely of an individual who proposed to make street gas by first producing hydrogen from the dissociation of water, and then carbonizing the gas. The *Chemist*, however, calculates that to make one cubic foot of hydrogen gas there will be required :

Oil of vitriol	0·26 lb.
Zinc	0·17 lb.

Or if iron be substituted for zinc

Iron	0·15 lb.

The cost of hydrogen by this process will be per cubic foot :

From Zinc.

Oil of vitriol, 0·26 lb. at 2½ cents	0·65 cent.
Zinc, 0·17 lb. at 8 cents	1·36 "
	2·01 cents.

From Iron.

Oil of vitriol, 0·26 lb. at 2½ cents	0·65 cent.
Iron (wrought scrap), 0·15 lb. at 2 cents	0·30 "
	0·95 cent.

Petroleum oil will not answer for carburetting this hydrogen, though if of a poor quality, that is, if it contains naphtha, etc., it will yield up these latter impurities and thus carburet a small volume of gas. Gasoline and benzol are the best carburetting liquids. Compared with ordinary coal gas, however, there is a great economy in the use of the latter. The highest price charged for coal gas is $4 per 1000 cubic feet, which would be 0·4 cent. per cubic foot against 2.01 cents, or 0·95 cent. for the hydrogen, to which must be added the cost of the carburetting material, as, of course, the hydrogen has no luminosity. So that the person, who proposes to furnish a six-feet-per-hour gas light, equal to ordinary coal gas, for 0·84 cents. per hour, is convicted of ignorant or fraudulent pretensions. If the carburetting material cost nothing, such a light could not be afforded for less than 5·7 cents. City gas works, which he claims to rival in economy, even at the high price of $4 per 1000 cubic feet, would furnish the same light for 2·4 cents.

MINING SUMMARY.

Utah.

The Emma Directors publish the following report from the new manager, Mr. ATWOOD :

(CONTINUED FROM LAST WEEK.)

All these explorations are being pushed night and day, Sundays as well. The surface of the ground being so thickly covered with snow, I find it impossible to start any new work from the surface, having no data or guide to aid me in exploring. This is unfortunate, because the extent of the company's ground is so great, and only a small portion of it has been worked hitherto. As soon as the snow permits this matter shall have my most earnest attention. The geological age of the formation in which the vein is found is evidently that of the Silurian ; but it is a question which it will take some time and careful examination to definitely fix. The amount of ground caved in June, 1872, I have marked off on the accompanying map, as near as possible, from measurements taken by the foreman and myself. The amount of ground liable to cave, if a large quantity of water gets into the mine from snow-melting this spring, I have also marked off on the plan. I am having this portion strengthened at all available points, but the former timbering has been so very defective that a great part of the timbers are already partially crushed ; but fortunately there is no ore left in that portion, and we are now preparing for the emergency by securing drift No. 7, so that the cave, if it occurs, cannot extend beyond the latter drift, and are also providing for ventilation in a like manner. Fillings containing ore I discovered in crawling through the old workings. The best sample came from mark, directly above the word "on" in drift No. 7 (see map), and think there is at the least 200 tons of the average sample called assay No. 2. The second lot, containing several hundred tons, are also directly above No. 7 drift, and extend for fifty feet in length, but are not as valuable as the first lot, called assay No. 2. The third lot extends for about forty feet in length above Pascoe Tunnel, and is called assay No. 3. The results are as follows from my own assays :—Sample of fillings taken from above drift No. 7 contained—Lead, 1 8-12 per cent. ; silver, per ton, ozs. 93 55=120.93 dols. The above sample after being boiled in distilled water, and also in concentrated ammonia, afforded the following results:—Silver, probably chloride of silver, 24·692 per cent. ; silver, probably sulphate of silver, 71·422 per cent. ; silver, probably sulphide of silver, 3·886 per cent.—total, 100 per cent. showing that 96·11 per cent of the silver is in a condition to work by amalgamation, without roasting and what is here termed "free milling ore." Assay No. 1 : Of 60lbs. of fillings from above drift, No. 7 contained lead 2½ per cent. ; silver, per ton, ozs. 52·24=67.54 dols. Assay No. 2 : Of 2nd class fillings from above drift No. 7 contained lead, 3 4-12 per cent. ; silver per ton, ozs. 2·794=36.23 dols. Assay No. 3 : of 2nd class fillings from first floor above Pascoe Tunnel, near extreme end of ore, contained lead, 4 1-6th per cent. ; silver per ton, ozs. 29·30=37.70 dols. It is almost impossible to ascertain the exact amount of the two last samples of fillings, but think there are upwards of 500 tons. At the present price of ten dollars per ton for hauling ore to Sandy Station from the mine, and then the long distance from that place to any custom mills, there is but a small margin for profit in taking out any of these fillings, but eventually they can all be worked to a good profit.

Since the above report was in type, the following further letters have been received from Mr. ATTWOOD, which appear to the directors to be more encouraging than the original report. Owing to the many discouraging rumors in circulation, the directors think it right to direct the attention of the shareholders to the fact stated

by the report, that a large portion of the property of the company still remains entirely unexplored.

29th March.—I left Salt Lake City this morning before daylight, and arrived here with the surveyor, Mr. FREEMAN, this afternoon. The Canyon road is still in a very bad condition, and it snowed very heavily all the day. I have just come out of the mine, and find no change for the better in any of the workings. I find that the "upper" portion of the engine shaft has moved since my last report of the 25th instant (having marked the timbers, &c.); so, considering the safety of the mine, have made arrangements to have the shaft re-timbered at once, and think it will take at least ten days. This will, of course, prevent hoisting ore, but have arranged to have the ore still taken out, and assorted underground; and as we have a large surplus in the ore-house, it will not interfere with us financially. I have had to offer 12 dols. per ton from the 1st April for hauling our ores from the mine to Sandy Station, until further notice, as I find it impossible to get but a small quantity of ore down at the present price of 10 dols. per ton.

30th March.—Inclosed you will please find ore account for the last week. You will notice that the amount of ore extracted is only 155 tons. The small output is occasioned by the great difficulty we find in assorting the ores, and also having to put such a large number of men on explorations and re-timbering the old workings to make them as secure as possible. The new explorations show as yet no change for the better, but cannot expect much improvement for some weeks to come. The new drift which I am running to connect with the winze below the PASCOE Tunnel is now in about ten feet, and is in hard limestone and requires blasting: to expedite that work have let a contract to some of the miners to run it for the sum of sixteen dollars per foot for sixty feet. I find we have about 120 feet to run it, by survey made to-day. The weather is still bad, and it has been snowing nearly all day. I have been in the mine all day (Sunday), and have been examining further into the question of "fillings," and find that we have a large amount of them, and am now making some experiments and analyses to see if it is not possible to turn them to good account at an early date. The following are the assays from two samples taken to-day:—Assay No. 1—Fillings from above drift No. 7 contained lead ¾ per cent.; silver per ton, ozs. 37·66=48·69 dols. Assay No. 2—Fillings from above drift No. 7 contained lead 3 per cent.; silver per ton, ozs. 35·23=45·55 dols.

31st March.—I have just completed some analyses on a large scale to prove the quality of the second class fillings in regard to the amount of "free milling silver" in the same. The results are as follows;—Assays of fillings from above drift No. 7, contained lead, ¾ per cent.; silver per ton: oz. 37·66=48·69 dols. Contained silver, probably as sulphide, 60 16 per cent.; chloride, 15·21 per cent.; sulphate, 24·63 per cent.; total 100·00 per cent., showing that only 39·84 per cent. of the silver is in a "free milling state" in the second class fillings. The working test, that is the only practical one that we can apply here for extracting the silver by "liquation" on a large scale, by using a concentrated solution of salt, does not give by four per cent. as good results as the above. I am going to send one ton of the average of the fillings down to Salt Lake City, and test them practically myself, to prove what can be done with them by amalgamation, as Mr. MACKINTOSH has a pan at his "sampling works" that will serve our purpose. The great mass of the fillings are in a powdered state, and will require but little, if any, crushing before they are put into the pan, and am in hopes that we can work them cheaply and profitably; if so, they ought to yield a large revenue, as there is a great quantity of them in the mine. The sample from the ore house of 1,550 sacks, or about 70 tons, taken to-day and assayed here, goes:—Lead per cent. 383; silver per ton, ozs. 55.89=77·26 dols. The assays made here from the lower grade of ores correspond closely with those taken at the sampling works for the buyers. The weather still stormy, and it has been snowing nearly all day.

1st April.—The only change I have to report to-day in the mine is an improvement in the lower winze, below the Pascoe Tunnel, an assay taken from the average of the bottom of which gave the following returns:—Contained lead. 7¼ yer cent.; silver per ton, 58·32 oz. 75·40 dol. An analysis made from the same to prove the amount of free milling silver shows that 31·26 per cent. of the silver is in a free state. The percentage of lead, as you will observe, is too small at present to pay for smelting.

Colorado.

From the April Number of the Colorado Mining Review.

GEORGETOWN MINES.

The Baltimore Tunnel Company are working the Baltimore lode, which was struck about 150 feet from the mouth. This vein is believed to be the same as the Terrible, and at the point cut showed a magnificent seam of ruby silver running through the vein.

The Hercules is finding better pay than ever. A lot of ore from that mine, yielding about 150 ounces in silver and 40 per cent. lead, was recently shipped to Michigan to be reduced with Silver Islet ore. The leasers on the Seven-Thirty are taking out some very fine ore. The Phœnix and Coldstream hill is active. Some new leases have been taken on it lately.

In Pratt's Tunnel, what is believed to be the west extension of the Coldstream has been struck. We have seen some handsome looking ore from the vein.

The excavations in the Pelican 4th level, at the head of the deep shaft, are finished, and the hoisting whim in working order. The chamber cut out measures about 24 feet each way. It was made upon what was supposed to be the south wall of the vein, but in cutting it, new seams of mineral have been found, showing that the true width of the Pelican has not, as yet, been certainly ascertained.

Work on the Antelope (west shaft) has been temporarily stopped by water. A four inch vein of rich ore was left in the lower drift. The Antelope tunnel is within 25 feet of the vein, and will cut it, it is expected, in about 30 days. The rock along the entire length of this work has been extremely hard, costing as high, at times, as $32.50 per foot.

The Diamond Tunnel is in about 80 feet, and has crossed two crevices, one of which was cut by the diamond prospecting drill, before the tunnel was commenced. In Cherokee Gulch, five long tunnels are being driven, to tap one or all of the veins now being worked on the surface. The shortest of these will be 240 feet, and the longest over 1,200. This belt of veins comprises the Baxter, Morse, Antelope, Eagle Bird, Pelican, Dives, and others, all of which are of known value. Experience in deep mining on Republican, Brown, and Sherman Mountains, has shown that more dependence can be placed upon the mineral bearing qualities of the veins at great depths, than of those on Leavenworth. It is not thought probable that the Diamond Company will cut lodes of any great importance, until in at least 250 or 300 feet from the foot of the mountain, and from 150 to 200 feet below the surface. One of the first lodes met with will be the Antelope, which comes down hill from its discovery shaft very considerably. The Baxter will be intersected about 270 feet deep, the Morse, which belongs to the Dives and Laura Dale belt, at something like 480 feet, and the Pelican at a point about 600 feet below its gulch adits. It is estimated that the tunnel will require to be driven 1,000 feet before this latter lode is reached.

The Burleigh Tunnel is nearly 1,400 feet long, and cannot be far distant from the Cashier, Phœnix, Virgin, Silver Spring, and Quaker. These lodes will be cut from 1,000 to 1,800 feet below their surface outcroppings.

A great deal of dead work is at present being done upon the Silver Plume and Snowdrift, with a view of a large yield during the summer.

The Matilda Fletcher is reported as in good pay, though in small quantities. It is at present about the only mine on Democrat Mountain that is producing anything.

The Grant lode at Swansea is turning out some fine ore, and the Oshkosh or England is, for the time at least, shut down.

Highland Park, and the mines in that vicinity, are doing nothing at present, though work is to be resumed on the Magnet and Comet early in the summer.

The John Bull, on Leavenworth, sends down occasional lots of ore to Silver Plume, that fully sustain its high grade reputation.

On the 20th of April, the drift from the Robinson Tunnel cut the McCoy shaft on the Colorado Central lode, 113 feet from the surface, or about 60 feet below bed rock. The drift is something over 320 feet long, from its point of departure from the tunnel.

Dr. Van de Voort made a descent upon the Stevens mine, Argentine, lately, and captured the whole outfit. It is claimed to be the same as the Fanny lode, an older location owned by the Doctor, and there is every indication that before long Stephen and Fanny will either become involved in the intricacies of the law, or effect a consolidation "for better and worse."

The International has been stocking up ore all the winter, and when the East Argentine road is cleared of snow, will send some fine ore to market. There is a report that the Baker lode is about to be re-opened, but whether by the owners, or otherwise, we are unable to state.

The Argentine mines, both east and west, will be worked by a larger number of miners this summer than ever before. A dozen parties, at least, in Georgetown, are only waiting for the snows to melt to start off prospecting and blasting.

Advertisements.

The special advantages of the ENGINEERING AND MINING JOURNAL, *as a medium for advertisers, are so great and so widely known that it may seem almost needless to call attention to them. It is extensively circulated among the engineers of the country and takes a position in this respect before any other publication of the kind. It has a large and constantly increasing circulation among miners and mine owners, and men connected with mining operations generally. As it is the only paper in the country that makes this subject a specialty it has this field entirely to itself, and is the only direct and reliable means of reaching this class of persons. Being kept on file by almost every subscriber, it is doubly valuable as a permanent means of keeping an advertisement before the public. It is the Organ of the* AMERICAN INSTITUTE OF MINING ENGINEERS, *and is regularly received and read* BY ALL THE MEMBERS AND ASSOCIATES *of that large and powerful society,* THE ONLY ONE OF THE KIND IN THIS COUNTRY. *It is therefore the best medium for advertising all kinds of machinery, tools and materials used by engineers or their employees. It is the recognized organ of the coal trade, and is taken extensively by the trade throughout the country, and presents the very best means of reaching that very important class of men.*

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Nov. 21:1y

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NOTICE is hereby given that the annual meeting of the stockholders of the Scientific Publishing Company will be held on Wednesday, May 21st, at 12 o'clock, at the office, 27 Park Place, New York City.

WM. VENTZ, Secretary.

may20-2t

MISCELLANEOUS.

BANKING HOUSE OF FISK & HATCH,
No. 5 NASSAU-ST., NEW-YORK, May 11, 1873.

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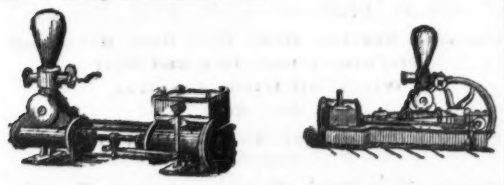

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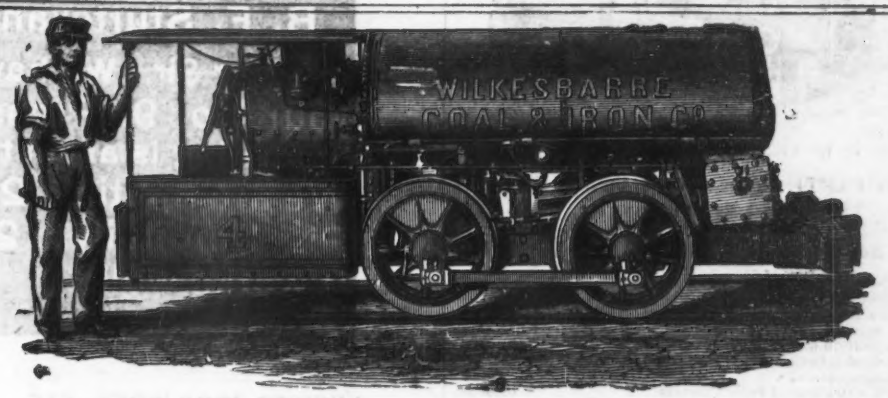

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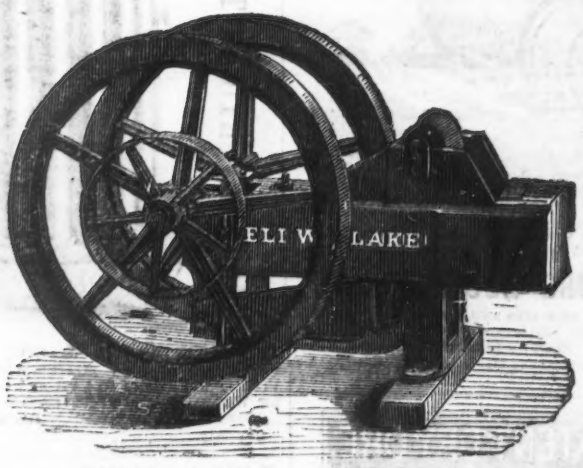

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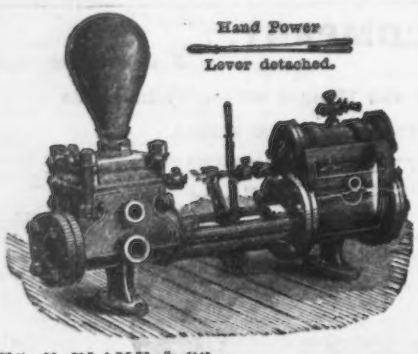

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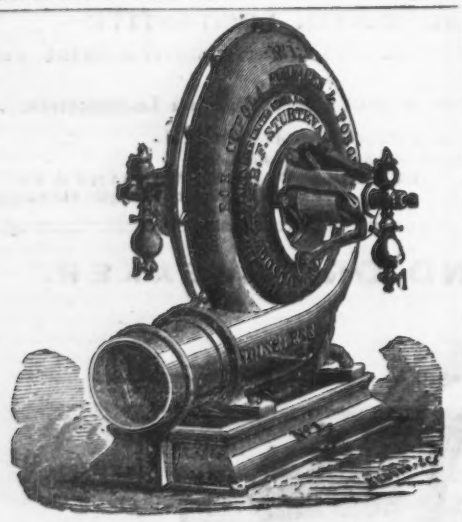

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FOR CUPOLA FURNACES AND FORGES.

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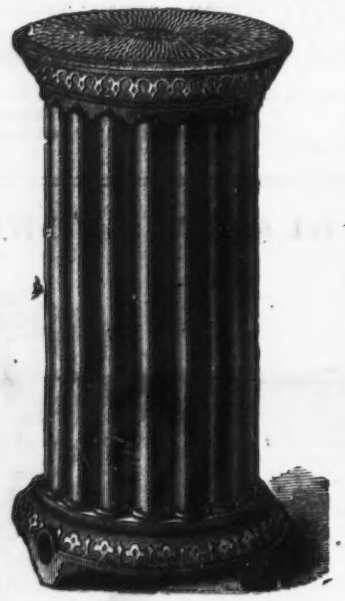

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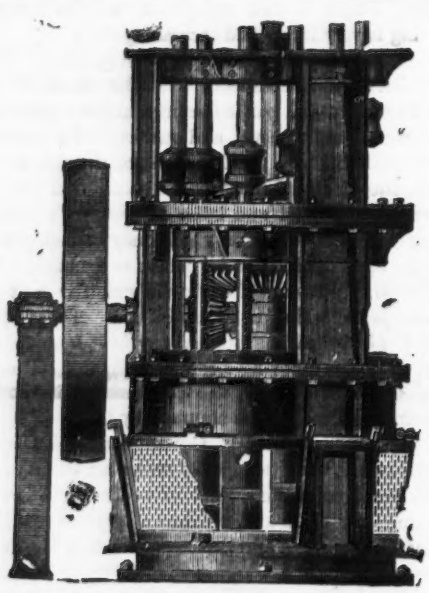

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Works at Trenton and Ringwood, N. J.
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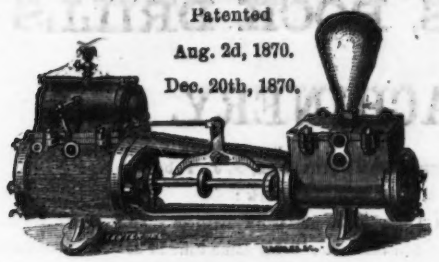
MISCELLANEOUS.

THE SELDEN DIRECT-ACTING
STEAM PUMP
A. CARR, Manufacturer & Proprietor.

Patented
Aug. 2d, 1870.
Dec. 20th, 1870.



Combining simplicity and durability to a remarkable degree Its parts are easy of access, and it is adapted to ALL PURPOSES for which Steam Pumps are used.

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It is unsurpassed. Also,

Steam, Gas and Water Pipe, Brass Work. Steam and Water Gauges, Fittings, etc. etc.

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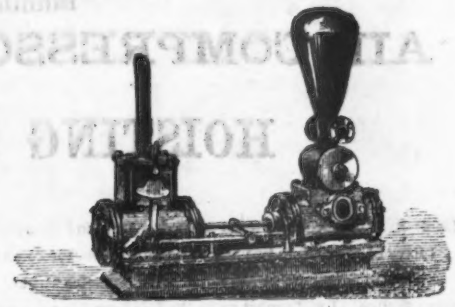
Niagara Steam Pump Works.



This Pump has taken the first premium at every Fair in the United States where there has been a practical test.

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Steam Pumping Engines, Single and Duplex, Worthington's Patent, for all purposes, such as Water Works Engines, Condensing or Non-condensing; Air and Circulating Pumps, for Marine Engines; Blowing Engines; Vacuum Pumps, Stationary and Portable Steam Fire Engines; Boiler Feed Pumps, Wrecking Pumps,

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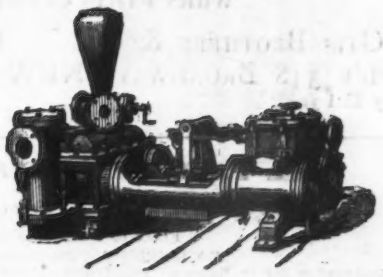

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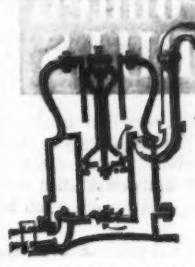

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The best dry coals shipped, and the promptest attention given to orders. sep21-1y

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FROM THE BUCK MOUNTAIN VEIN.
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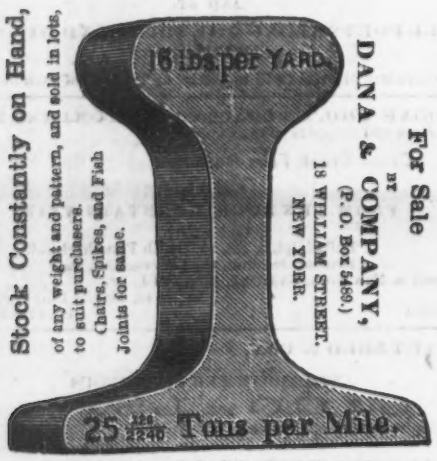

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HOISTING ENGINES.
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Special adaptation for MINES and FURNACES.
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FRICTION OR GEARED MINING AND QUARRY HOISTERS.
For Hoisting and Conveying Material to any Distance by Wire Cables.
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They are adapted to CHANNELLING, GADDING, SHAFTING, TUNNELLING and open cut work; also to DEEP BORING for TESTING the VALUE of MINES and QUARRIES. TEST ORES taken out, show the character of mines at any depth. Used either with steam or compressed air. Simple and durable in construction and never need sharpening.

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